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Michigan Forest Resource Assessment and Strategy

photos by Dave Kenyon, DNRE

Michigan Department of Natural Resources and Environment
Forest Management Division

IC4043 (06/23/2010)

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MICHIGAN DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENT

FOREST MANAGEMENT DIVISION

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Michigan Forest Resource Assessment and Strategy

David L. Price, Editor

APPROVED:

Cara A. Boucher, State Forester — 10 June 10 Date

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Preface and Acknowledgements

Private lands contain approximately one-half of the forest resources of the State of Michigan. The Michigan Department of Natural Resources and Environment (DNRE), Forest Management Division, has several cooperative programs that have a primary focus for providing technical and financial assistance for the sustainable stewardship of private forest resources. These include the Forest Health, Forest Legacy, Forest Resource Protection, Forest Stewardship, and Urban and Community Forestry programs. This Michigan Forest Resource Assessment and Strategy is a major step toward greater integration of cooperative forestry programs for the long-term, sustainable stewardship of the private forest resources of Michigan.

Contributors to this planning project include the following DNRE staff: Cara Boucher, David Drullinger, Dr. Kerry Fitzpatrick, Greg Goudy, Debra Huff, Paul Kollmeyer, Steve Kubisiak, Roger Mech, Dr. Lawrence Pedersen, Dr. Georgia Peterson, Kevin Sayers, Mark Sargent, Steve Sutton, Anthony Weatherspoon, and Kerry Wieber.

Special thanks to Lisa Dygert for GIS support and to Sally Rankin and Margaret Spagnuolo for formatting of the draft and final documents.

I. Introduction to National and Regional Overview of State Assessments

The Food, Conservation, and Energy Act of 2008 amended the Cooperative Forestry Assistance Act of 1978 by adding a requirement for **Long-Term State-wide Assessments and Strategies for Forest Resources.** A Forest Resource Assessment and Strategy is required for a State to be eligible for funds available under Cooperative Forestry Assistance Act authorities.

The purpose of this effort is to strategically assess forest resources, areas and conditions and frame or identify rural and urban forest issues and landscapes. It considers state, federal and private lands and incorporates existing forest management plans including state wildlife action plans and community wildfire protection plans. This comprehensive approach will support integrated investments that promote sustainable forest management and produce significant benefits for current and future generations.

The United States Department of Agriculture (USDA) Forest Service (FS) State and Private Forestry Program (S&PF), the National Association of State Foresters (NASF) and the NASF regional organizations worked cooperatively to identify three national priorities: Conserve Working Forest Landscapes; Protect Forests from Harm; and Enhance Public Benefits from Trees and Forests. These 'Redesign' themes are further detailed with related objectives in Table 1.1.

Table 1.1. S&PF National Themes and Objectives.

1.	**Conserve and Manage Working Forest Landscapes for Multiple Values and Uses**
1.1.	Identify and conserve high priority forest ecosystems and landscapes
1.2.	Actively and sustainably manage forests
2.	**Protect Forests from Threats**
2.1.	Restore fire-adapted lands and/or reduce risk of wildfire impacts
2.2.	Identify, manage, and reduce threats to forest and ecosystem health
3.	**Enhance Public Benefits from Trees and Forests**
3.1.	Protect and enhance water quality and quantity
3.2.	Improve air quality and conserve energy
3.3.	Assist communities in planning for and reducing wildfire forest health risks
3.4.	Maintain and enhance the economic benefits and values of trees and forests
3.5.	Protect, conserve, and enhance wildlife and fish habitat
3.6.	Connect people to trees and forests, and engage them in environmental stewardship activities
3.7.	Manage trees and forests to mitigate and adapt to global climate change

* These national objectives were approved by the S&PF Redesign Implementation Council and by NASF, September 2008.

The Michigan Department of Natural Resources and Environment (DNRE) conducted a statewide assessment to analyze forest conditions and trends and to delineate rural and urban forest issues and landscapes. From this state assessment, the DNRE developed a statewide forest resource strategy that will provide direction and guidance for current and future investments.

Michigan's assessment and strategy planning process conforms with the three required components in the planning process:

- *Statewide Assessment of Forest Resources* - In order to ensure that S&PF resources are being focused on high priority issues and areas with the greatest opportunity to achieve meaningful outcomes, the DNRE worked collaboratively with the USFS and other key partners to develop a comprehensive statewide assessment of forest resources. This assessment provides a comprehensive analysis of the forest-related conditions, trends, threats, and opportunities in Michigan, and delineates priority rural and urban forest landscape areas. The statewide assessment of forest resources provides a valuable and unique opportunity to highlight the full scale of work needed to address priorities in the forests of

Michigan and in some instances across multiple states. At a minimum, the statewide assessment of forest resources:

- Describes forest conditions on all ownerships in the state.
- Identifies forest-related benefits and services.
- Identifies threats to the forest resources.
- Highlights issues and trends of concern, as well as opportunities for action.
- Delineates high priority forest landscapes to be addressed.
- Is geospatially based and makes use of the best existing data.

- *Statewide Forest Resource Strategy* - Statewide forest resource strategies were developed on the basis of the priority issues and areas identified in the state assessment, where an investment of federal competitive grant funding could most effectively accomplish goals or leverage desired action and engage multiple partners. Each cooperative program addresses one or multiple priority issues and provides program-specific goals that will work to address the strategies.
- *Annual Report on Use of Funds* - Describes how S&PF funds were used to address the assessment and strategy, including the leveraging of funding and resources through partnerships, for any given fiscal year.

It is important to note that this strategy is not the only plan which addresses the management of forest resources in Michigan. There are many other federal and state planning processes and documents that provide direction for management of national and state forests, parks, and other public lands. This strategy document does not statutorily provide any explicit direction to these other planning processes, but it does seek to provide some degree of implicit consistency in addressing priority issues that apply across multiple forest resource ownerships in Michigan.

In this regard, the Michigan Forest Resource Assessment and Strategy is complementary to other strategic plans and programs that help to address the three national themes, and that foster stewardship and sustainable management of both federal and state forest resources. The state forest is certified for sustainable management under the standards of the Forest Stewardship Council and the Sustainable Forestry Initiative, which is also consistent with the three national themes. DNRE Planning processes (ecoregional resource plans, and Regional State Forest Management Plans) that are consistent with these certification standards and national themes may be integrated with future revisions of the Michigan Forest Resource Assessment and Strategy. Thus focusing the forest resource assessment on *all lands* — state, private, and federal — and strategically assessing the forest areas that have the greatest need, highest value, or innovation potential, will help to make the most out of every dollar invested under state and private forestry programs. The result will be healthier and more resilient landscapes, better and more fire-adapted communities, improved habitat, air, and water quality, and a host of other public benefits that come from actively and sustainably managed forests.

II. Forest Conditions and Trends

The present forests of Michigan are a legacy of natural vegetative succession pathways and post-settlement practices. The landscape is mostly composed of second growth forests that have been heavily influenced by a variety of human-induced disturbances. This started with harvesting of white and red pine and many other species, followed by large-scale catastrophic wildfires fueled by the resulting slash, and then moving to a period of near total exclusion of fire from the landscape. Beginning in the early 1900s, the forests have been undergoing almost a century of gradual re-growth. Few of these secondary forests possess the structural characteristics of the circa 1800 forests. With the exception of some rare community types, the state's present population levels, ownership patterns, and social and cultural values preclude the restoration of our remaining forests to circa 1800 conditions. Such restoration would necessitate dramatic changes in timber production, wildlife management and many forms of recreation.

The re-growth of the forest resource has presented us with more choices for management of these resources, including timber production, many forms of recreation, the provision of terrestrial and aquatic wildlife habitat, and the provision of other ecosystem services. However, this has also made management of these resources more contentious, as different interests compete to use the state's forest resources for conflicting purposes. The capacity of forest resources to provide for these uses in a sustainable manner is finite. Since uses and non-uses are not perfectly compatible, the forest cannot provide maximum use for all demands. Provision of one use is often constrained by demands for other competing uses for the same resource, and the capacity of the forest base to provide for competing uses is infinite in its variability. Thus, the annual capacity of forest resources must be framed in terms of balancing competing uses. Emphasis should be on the means to enable uses to be compatible with other uses, with the recognition that at any one site, one value or use may predominate over others.

In order to effectively formulate appropriate management strategies in this environment, it is helpful to have an understanding of the changes in forest composition and structure that has occurred and the ecological consequences of those changes. An understanding of how historical events have led to current forest conditions, coupled with an analysis of current inventory data and current uses of the forest resource base can provide the foundation for present strategies and future structural changes that will support sustainable forest management.

This section describes the current condition of Michigan forest resources and the current capacity of its uses. It will also explore the ecological consequences of these uses in terms of changes in composition and structure. The analysis of forest resources in this statewide assessment and strategy is in part, based on geospatial modeling.

2.1 General Land Cover and Forest Resource Base

Five statewide forest inventories were conducted by the USFS during the last century, and data now is being added to update the inventory on an annual basis. These inventories indicate that forest acreage has remained relatively stable since the 1950s, at approximately 19.3 million acres (Figure 2.1). Losses or conversions out of forestland between have tended to be compensated for by other lands being converted into forestland. The predominant land type converting into forestland has been agricultural land. In contrast to the stable forest acreage, total standing timber volumes have tripled since the middle of the last century, reflecting a maturing forest.

The expanding volume also indicates that more growth has been continuously added to the forest than what has been removed or died through natural causes, as evidenced by annual growth that has increased over the past 50 years (Figure 2.2). Michigan's surplus growing stock (annual net growth less harvests) is among the largest in the nation, with forests currently growing more than twice as much wood than is being harvested each year, and this trend is expected to continue. The majority of annual net growth occurred in the hard and soft maple, white and red pine, cottonwood, and aspen forest types. However, this growth does not imply that the state is becoming increasingly covered by large contiguous tracts of forestland. Rather, as the landscape has been slowly restored and forests have matured, it has become increasingly

fragmented by roads and other development. This has had negative effects upon interior forest wildlife species, and conversely had positive effects upon wildlife species adapted to open and edge habitats.

On a statewide basis, the largest forest type currently is northern hardwoods (5 million acres), followed by the aspen-birch association (3.2 million acres), mixed oak-hickory (2.6 million acres), aggregate pine communities (2.4 million acres), cedar and mixed conifer swamps (2.1 million acres), and southern (or central) hardwoods (1.5 million acres) (Figures 2.3 and 2.4).

With an understanding that classification systems tend to simplify forest types, (which in reality are often quite heterogeneous in composition) several general trends are apparent when comparing the relative areas of the circa 1800 forests to the area of current forestland (Table 2.1). The aspen-birch association, black ash, red pine, jack pine, mixed oak-hickory and cedar forest types now cover a much larger proportion of the landscape than their circa 1800 extent. The aspen-birch association has increased in acreage by almost 1,000 percent, whereas the savanna and barrens communities, hemlock, southern hardwoods, mixed conifer swamp, mixed white pine types, northern hardwoods, and spruce-fir types now cover a smaller portion of the landscape than their historical extent. Savanna and barren communities, and hemlock types are now almost completely absent from the landscape.

The estimated extent of commercial timberland has changed significantly from the first statewide inventory in 1935 through 2008 for forest-type groups, and some qualitative (but not quantitative) trends can be determined (Figure 2.5). A detailed discussion of trends for different forest types follows.

The extent of the aspen-birch association has increased from less than 1 to over 16 percent of the forested landscape (Table 2.1). It is important to note that this comparison concerns larger, stand-level aspen communities. Aspen was historically a minor component of many circa 1800 forest communities and is likely underrepresented in the reconstructed maps of the circa 1800 landscape. Regardless, the large increase in acreage can be attributed to the extensive areas of the state that repeatedly burned and where secondary succession of these two seral species occurred in the late 19th and early 20th centuries. Net growth of aspen on a statewide basis is estimated to be one-third greater than that of removals (Table 2.2). However, it is significant that mortality of aspen exceeds that of removals by a ratio of 1.4:1, suggesting that a large volume of aspen is not being harvested and is likely senescent in mixed stands that are succeeding to other forest types. The net growth of birch is estimated to be over 1.5 times that of mortality and removals, and removals are almost twice that of mortality.

To a large degree, contemporary management practices have perpetuated the aspen community type. However, the aspen-birch association has been in decline since 1935 (although the decline has become much less dramatic starting in the 1990s); again reflecting natural succession to more diverse late-successional community types (Figure 2.5).

This modern decline of seral aspen-birch association forests has major consequences for hunting interests that have become accustomed to high populations of game species that are adapted to and have thrived in this habitat, including grouse, woodcock, and white-tailed deer. If the proportion of aspen-birch association forest continues to decline, it is probable that populations of these game species will also decline. This also has significant ramifications for the timber industry which currently relies upon aspen as a major source of wood fiber.

The general ascending trend of the maple-beech-birch group and the decline in aspen-birch may be linked through aspen-birch succession to shade tolerant northern hardwoods (Figure 2.5). When compared to the circa 1800 landscape, mesic northern hardwoods now cover 2.5 million fewer acres (a 34 percent decline), but they have increased from 21 percent to 26 percent of the relative forest cover in the landscape and continue to slowly reoccupy areas of their historic range (Table 2.1). Growth is almost twice that of natural mortality and removals, and removals well exceed mortality (Table 2.2). A mere 0.4 percent of mesic northern hardwoods in Michigan remain in circa 1800 condition (with a highly diverse structure and species composition), with 59 documented occurrences. Of these, only 8 occurrences totaling about 56,000 acres are high quality representations of this cover type (Cohen 2000).

Since circa 1800, the acreage of mixed oak-hickory forests has increased by 300,000 acres (13 percent), and the relative area has doubled from 6.5 percent to 13.5 percent of the forested landscape (Table 2.1). This trend is also a legacy of turn of the century forest fires, to which the regeneration of oak is adapted. The ascending trend of the dry-mesic oak-hickory forest type may also be attributed to the general warming of the climate since the 1800s. Growth of oak is estimated to exceed that of mortality and removals by a ratio of 1.7:1, and removals well exceed natural mortality (Table 2.2).

Since circa 1800, mixed hardwood swamps have decreased by 586,000 acres (41 percent) to 835,000 acres in overall area, but this loss has been partially offset by an increase in black ash swamps which increased by over 140 percent to 681,000 acres (Table 2.1). The acreage of lowland hardwoods has been on a general upward trend until the 1960s, with a slight decrease in acreage since that time, possibly attributed to increased pressure from development (Figure 2.4). Growth exceeds losses by mortality and removals by a ratio of 1.5:1. However, losses from mortality are over twice that of removals (Table 2.2). As discussed further in the section on forest health, disease and pests have affected the composition of lowland hardwood forests. American elm *Ulmus americana* was virtually eliminated by Dutch elm disease as a dominant overstory tree in many floodplain forests. The invasion of the emerald ash borer *Agrilus planipennis* threatens to further alter the species composition and structure of these forests.

The hemlock component has precipitously declined in many forests of the state. Hemlock formerly covered 13.5 percent of the landscape and now comprises less than 1 percent of forestland, declining by over 97 percent from an area of 4.7 million acres to little more than 100,000 acres (Table 2.1). Hemlock was a co-dominant species in 6.3 million acres (85 percent) of the circa 1800 northern hardwood forests, both in terms of density and dominance (Table 2.1). In the circa 1800 landscape, there were four primary hemlock associations: pure hemlock (902,000 acres), hemlock-white pine (1,060,000 acres), hemlock-sugar maple (2,326,000 acres), and hemlock-yellow birch (295,000 acres). The decline in hemlock can be attributed to several factors, including climate, disturbance, land-use history, and reproductive/life-history requirements of the species (Mladenoff and Sterns 1993). In the late 1800s, large areas of hemlock were harvested for the bark, which was used in tannin mills. The primary controlling factor governing rates of hemlock regeneration is likely the presence or absence of residual seed trees. Other factors are the shade-tolerant nature of hemlock, the historic occurrence of frequent destructive fires, the elimination of large-diameter woody debris nurse logs, and increased herbivore pressure, which have combined to inhibit the effective recruitment of hemlock throughout many portions of the landscape.

Since circa 1800, the mesic southern hardwoods community type has declined by 4.3 million acres (74 percent) from almost 17 to 8 percent of the forested landscape (Table 2.1). In large part, this loss is due to conversion of this forest type to farmland and progressively to urban/open land, which when combined now occupy over 15 million acres of the landscape (Figure 2.4). There are currently 39 documented occurrences totaling 2,505 acres of the mesic southern hardwoods community in Michigan. Of these, only six occurrences totaling less than 100 acres are high quality representations of this cover type (Cohen 2004).

Mixed conifer swamps declined by almost 3.6 million acres (84 percent) since circa 1800, from over 12 percent to under 4 percent of the forest landscape (Table 2.1). This loss can be attributed to two primary factors: the historic clearing and draining of portions of this community type for agriculture, and the logging and conversion of the community to shrub-carr wetlands, which have increased in extent by almost three-quarter of a million acres. Conversely, the acreage of cedar swamps has increased by almost 8 percent since circa 1800, and has almost doubled its relative coverage of the landscape. The volume of cedar is increasing as growth is more than twice that of mortality and harvests combined. In turn, losses to mortality are more than twice that of timber harvest volume due to the relatively low use of cedar timber resources (Table 2.2). However, some growth is unused with losses of cedar through natural mortality being more than twice the volume that is removed by timber harvest. Of note, the trend of growth and mortality of black spruce is similar to that of cedar, with excessive losses also due to natural mortality.

There are three historic primary pine associations in Michigan: the mesic white-red pine forest; the dry northern forest dominated by jack and red pine; and the dry-mesic northern forest dominated by white pine and oak species. When considering the white pine communities (Table 2.1), the greatest changes are apparent in the various white pine communities, which have declined by over 80 percent (2.4 million acres in

aggregate), from almost 7 percent to little more than 2 percent of the landscape. The mixed pine-oak forest type (82 percent of which historically consisted of white pine and white oak) has declined by almost 200,000 acres (35 percent) since circa 1800. These declines may be attributed to the historic loss of white pine seed trees from the landscape and repeated wildfires during the post-logging era, which greatly inhibited the natural reproduction of this species. Conversely, relatively pure red pine forests have increased by almost 300,000 acres (51 percent), and relatively pure jack pine communities have increased by over 118,000 acres (20 percent). However, even with this increase, the proportion of pine dominated forests in the overall landscape has decreased by over 1.7 million acres. Remnants of the dry northern and dry-mesic northern pine forests are among the rarest forest types in the Great Lakes region. Just over 0.2 percent of dry-mesic northern forest remains in circa 1800 condition in Michigan, with 34 documented occurrences. Of these, only 9 occurrences constituting just over 4,000 acres are of high quality (Cohen 2002a). There are 14 documented occurrences of the red pine variant of the dry northern forest in Michigan. Only 6 of these occurrences totaling over 600 acres are of high quality (with large boles and a more open, two-tiered canopy structure). The jack pine variant of the dry northern forest is more secure in Michigan, totaling over 333,000 acres (Cohen 2002b).

Intensive reforestation efforts in the early to mid-1900s have contributed to a doubling of the area of white, red and jack pine forests since 1935 (Figure 2.5) to around 2 million acres. Due to this effort, the restored pine forests are a resource that would have otherwise not existed in any significant volume. However, these efforts initiated the management of white, red and jack pine as monocultures, which have been perpetuated due to economic efficiency and demand. This requires less complicated silvicultural management techniques, but also results in less landscape biodiversity. The complex composition and structure of circa 1800 dry northern, dry mesic, and pine and pine-oak barrens are barely represented in the current forest landscape. Furthermore, the modern exclusion of frequent and large scale fires from the forested landscape has greatly suppressed the natural regeneration of shade intolerant pine species. There is evidence that mid-shade tolerant white pine is regenerating in the understory of many current oak, red pine and aspen stands, portending a resurgence in the mixed pine-oak and mixed red-white pine forest types.

The mixed oak savanna, oak-pine barrens and prairie communities were significant components of the circa 1800 landscape, occupying over 2.1 million acres in mostly the Southern Lower Peninsula (Table 2.1). Due to the suppression of wildfires and their ease of conversion to agricultural land, these communities have declined by over 99 percent, and are now only represented by small fragments that are scattered throughout the landscape. There have been major ecological consequences for plant and animal species that were adapted to savanna and prairie communities, as they have also largely disappeared from the landscape and many remain imperiled as threatened and endangered species. In the Northern Lower Peninsula, circa 1800 pine barren communities covered almost 270,000 acres of the landscape. Today, fewer than five high quality occurrences are known in Michigan, totaling only a few hundred acres.

2.2 Distribution and Abundance of Urban Forests

(The following information is excerpted from the USDA Northern Research Station's publication, Urban and Community Forests of the North Central East Region (General Technical Report, NRS-54, September 2009)).

Urban or community land in Michigan comprises about 7.3 percent of the state land area in 2000, an increase from 6.5 percent in 1990. Statewide tree canopy cover averages 42.9 percent and tree cover in urban or community areas is about 21.0 percent, with 24.2 percent impervious surface cover and 27.8 percent of the total green space covered by tree canopy cover. Statewide, urban or community land in Michigan has an estimated 107.8 million trees, which store about 20.6 million metric tons of carbon ($469.7 million), and annually remove about 678,000 metric tons of carbon ($15.5 million) and 14,820 metric tons of air pollution ($121.7 million).

2.3 Current Forest Ownership and Trends

There is a high diversity in the type of forest ownerships in Michigan, with equally diverse management priorities and objectives (Figure 2.6). Forest ownerships in Michigan can generally be classified into public and private categories. Public forests can be further classified into federal lands (National Parks, National

Forests, and National Wildlife Refuges), state lands (state parks, state forest, and state wildlife areas), and county and local unit of government lands (parks and forests). Private forests can be further subdivided into industrial (Timber Corporations, Timber Investment Management Organizations, and Real Estate Investment Trusts), Conservancies, tribal lands, and private citizen ownerships. Ownership of some lands has been changing and available data is not completely up-to-date.

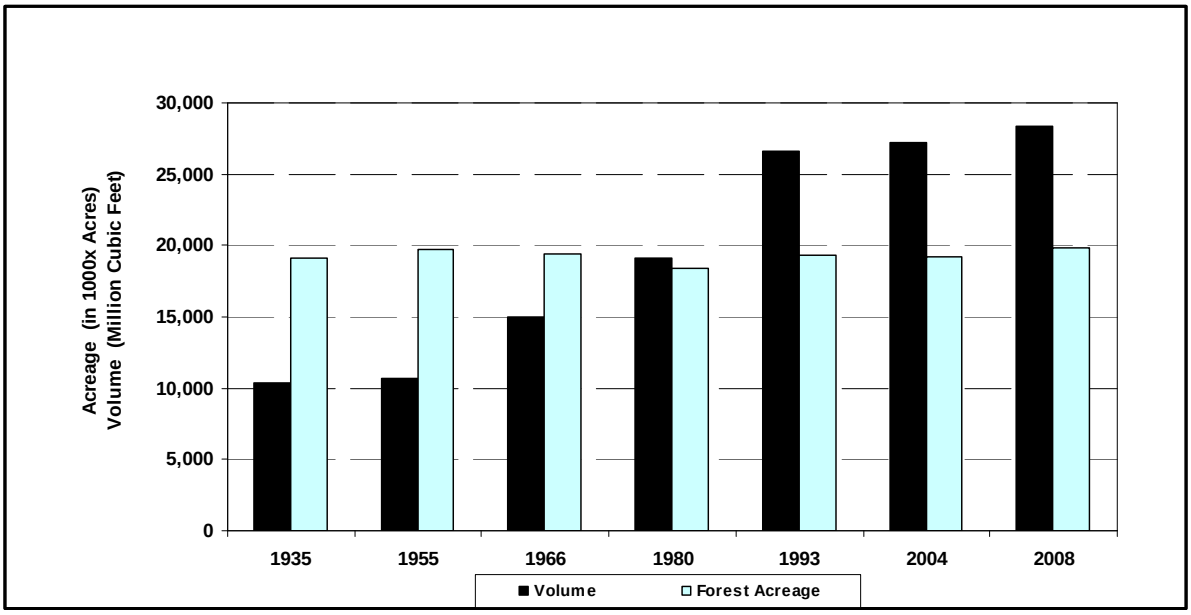


Figure 2.1.–Acreage and volume of Michigan forest from 1935–2008 (U.S. Forest Service 2010).

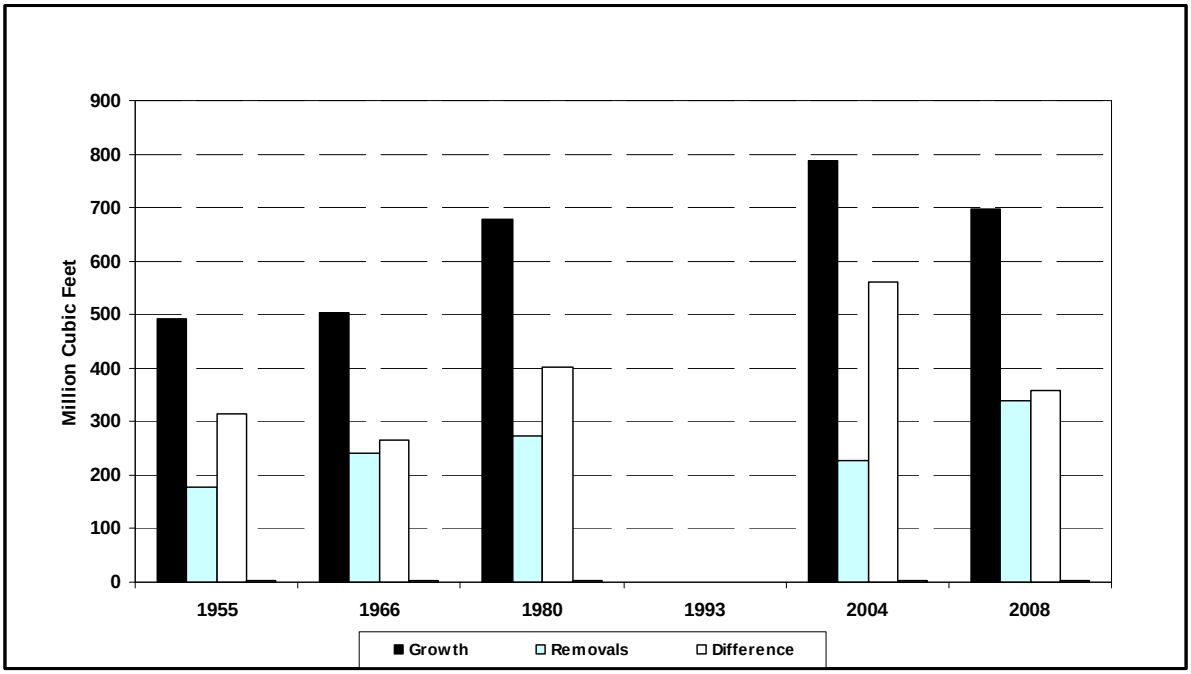


Figure 2.2.–Volume of Michigan Timber Growth and Removals for 1955–2008 (U.S. Forest Service, 2010).

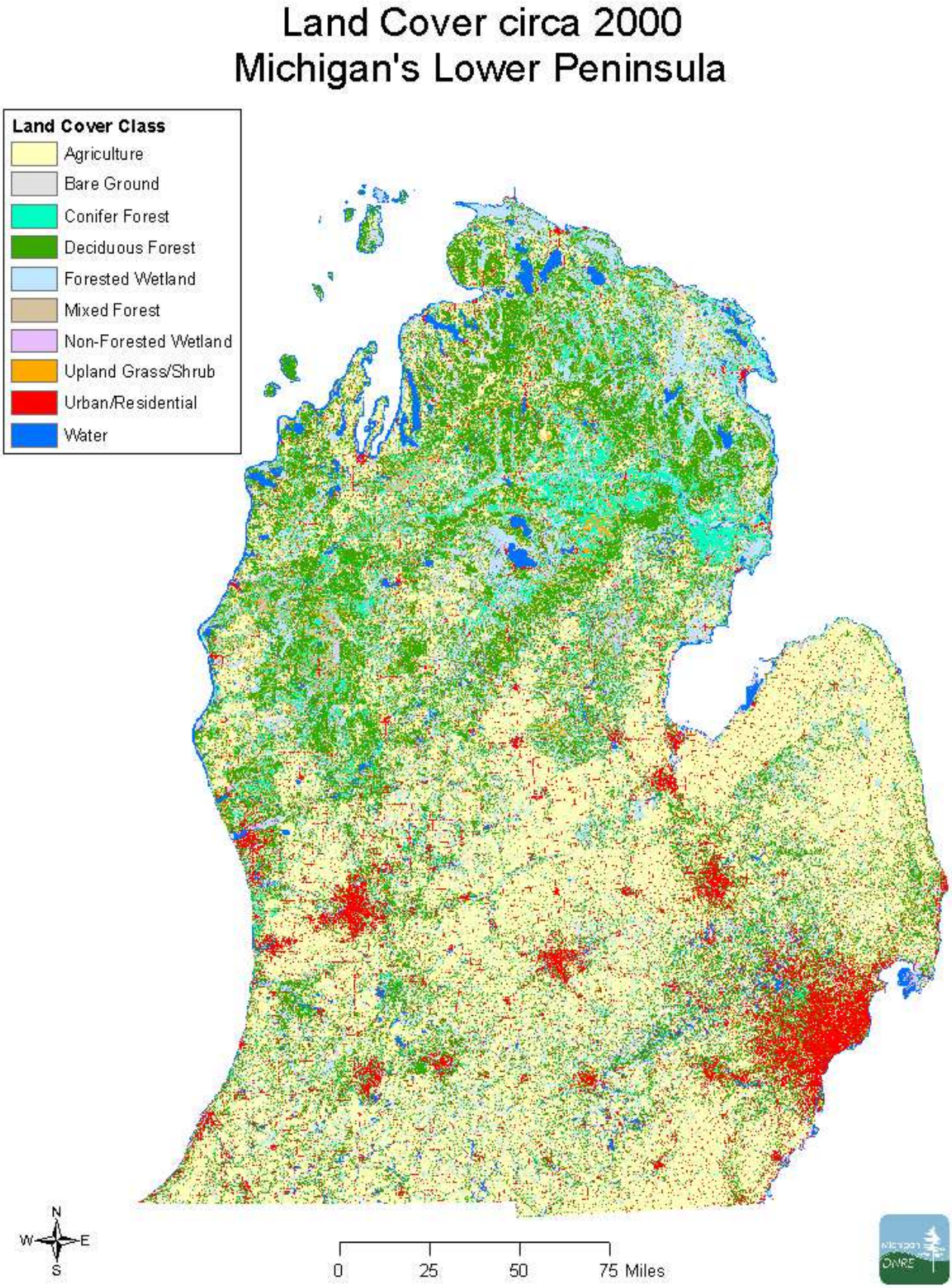


Figure 2.3.–Land cover of Michigan circa 2000 (Michigan DNR 2001).

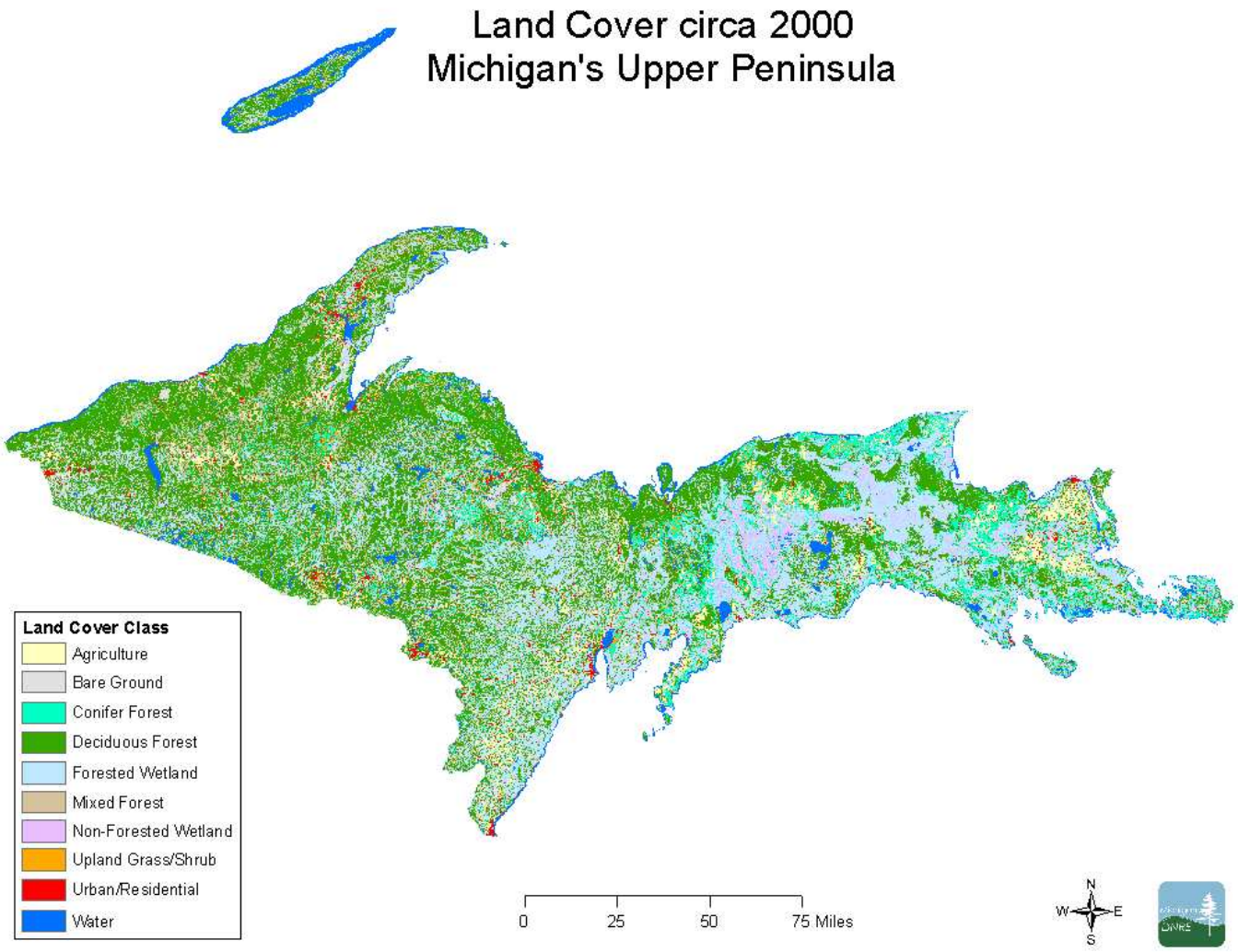


Figure 2.3.–Continued.

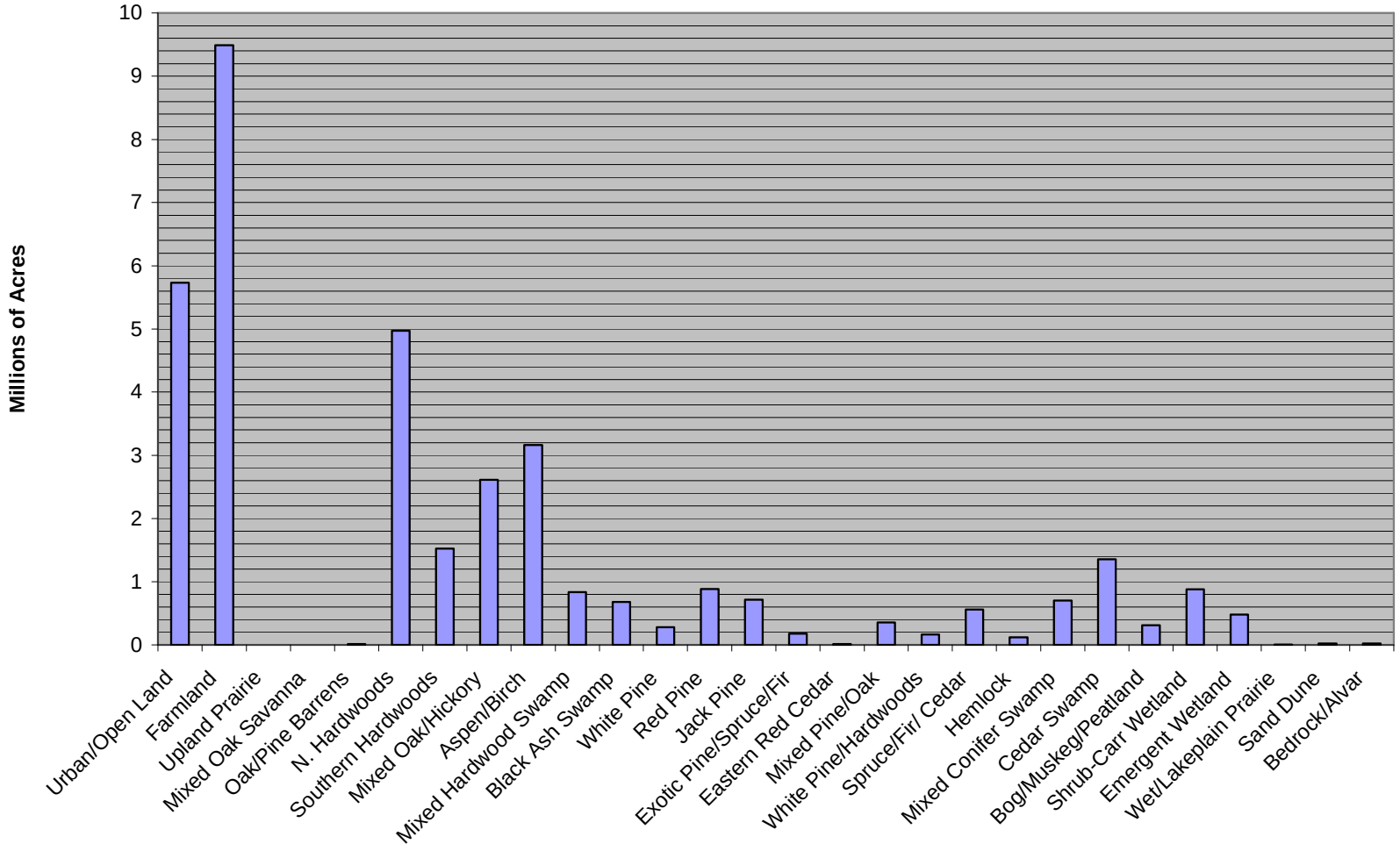


Figure 2.4.–Acreage of circa 2000 landscape communities (U.S. Forest Service 2003; MDNR 2001).

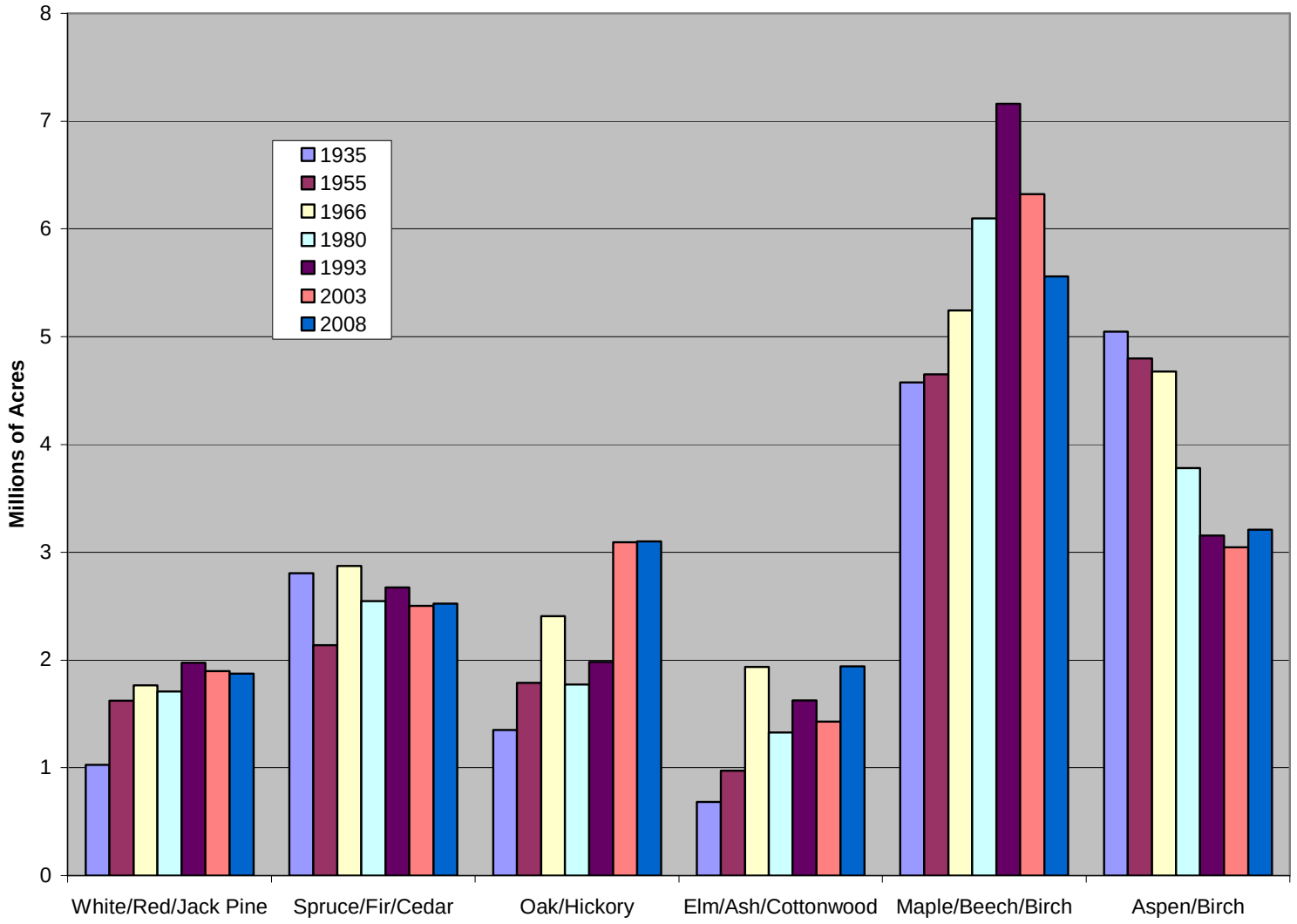


Figure 2.5.–Area of commercial timberland by major forest type group for 1935–2008 (U.S. Forest Service 2009).

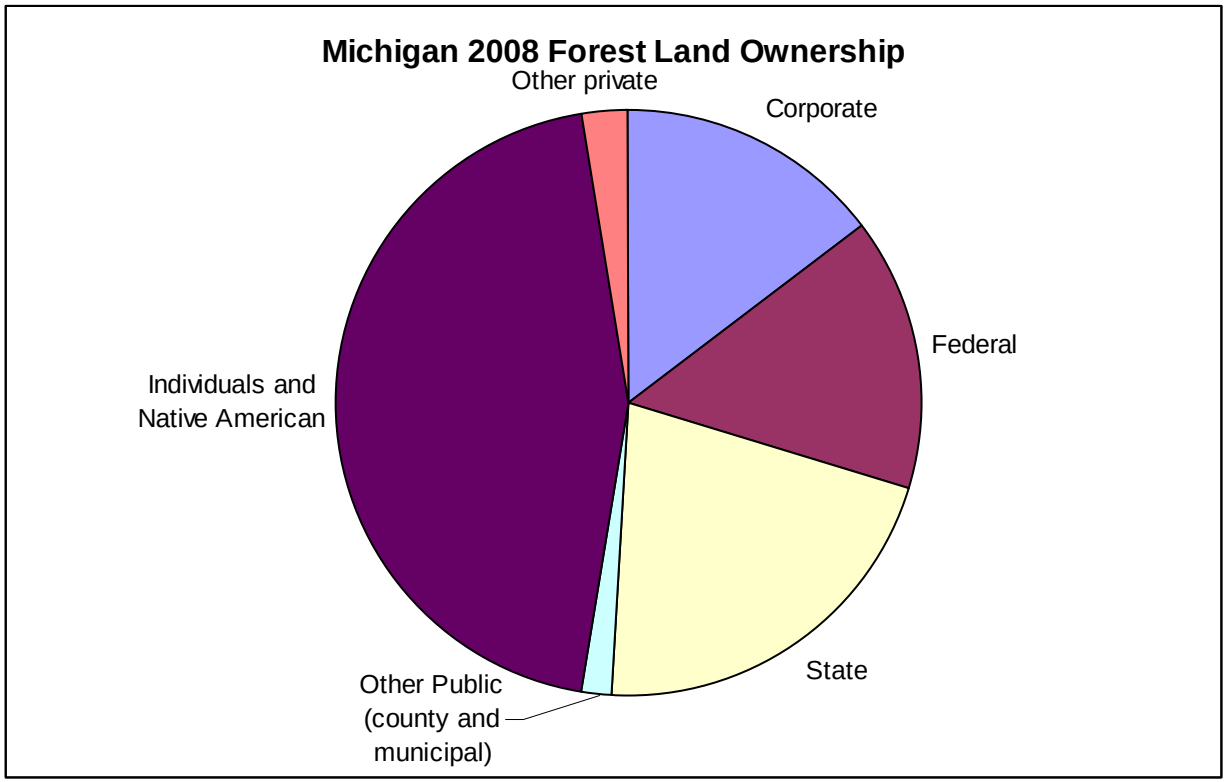


Figure 2.6.–Michigan Forest Land Ownership, 2008 (U.S. Forest Service 2010).

Table 2.1.–Change in Acreage of Forestland from Circa 1800 to Circa 2000 (Michigan Natural Features Inventory 1998; DNR 2001; USFS 2003).

Michigan Forestland	Circa 1800 Acreage	Circa 1800 Percent	Circa 2000 Acreage	Circa 2000 Percent	Change in Acres	Change in Percent
Aspen-Birch	292,266	0.8	3,163,200	16.5	2,870,934	982.3
Black Ash Swamp	280,705	0.8	680,700	3.6	399,995	142.5
Cedar Swamp	1,254,055	3.6	1,351,700	7.1	97,645	7.8
Eastern Red Cedar	0	0.0	11,500	0.1	11,500	NA
Exotic Pine-Spruce-Fir	0	0.0	178,600	0.9	178,600	NA
Hemlock	4,714,602	13.5	118,800	0.6	-4,595,802	-97.5
Jack Pine	596,836	1.7	715,300	3.7	118,464	19.8
Mixed Conifer Swamp	4,290,553	12.3	701,200	3.7	-3,589,353	-83.7
Mixed Hardwood Swamp	1,421,462	4.1	834,900	4.4	-586,562	-41.3
Mixed Oak Savanna	1,061,564	3.0	1,500	0.0	-1,060,064	-99.9
Mixed Oak-Hickory	2,306,373	6.6	2,612,500	13.7	306,127	13.3
Mixed Pine/Oak	543,562	1.6	352,700	1.8	-190,862	-35.1
N. Hardwoods	7,503,633	21.4	4,971,900	26.0	-2,531,733	-33.7
Oak-Pine Barrens	1,101,424	3.1	11,400	0.1	-1,090,024	-99.0
Red Pine	70,889	0.2	886,000	4.6	815,111	1149.8
Red-Jack Pine	515,819	1.5	0	0.0	-515,819	-100.0
S. Hardwoods	5,845,677	16.7	1,520,400	8.0	-4,325,277	-74.0
Spruce-Fir-Cedar	823,253	2.4	557,700	2.9	-265,553	-32.3
White Pine	69,141	0.2	278,600	1.5	209,459	302.9
White Pine-Mixed Hardwoods	1,185,681	3.4	164,500	0.9	-1,021,181	-86.1
White-Red Pine	1,132,097	3.2	0	0.0	-1,132,097	-100.0
Totals	35,009,592	100	19,113,100	100	-15,896,492	-45.4

Table 2.2.–Volume of Growth, Mortality, and Removals by Forest Type in Michigan (cubic feet; USFS 2004).

		Total			Ratio			
Forest type	Net growth	Mortality	Removals	Mortality and Removals	Growth to total mortality and removal	Growth to Mortality	Growth to Removal	Mortality to Removal
Aspen	97,155,271	38,588,139	28,354,437	66,942,576	1.5	2.5	3.4	1.4
Balsam Fir	11,585,489	4,457,673	3,062,002	7,519,675	1.5	2.6	3.8	1.5
Balsam Poplar	10,250,811	4,898,801	4,549,407	9,448,208	1.1	2.1	2.3	1.1
Birch	10,866,444	2,777,660	4,190,290	6,967,950	1.6	3.9	2.6	0.7
Black Spruce	12,686,731	4,475,210	1,676,417	6,151,627	2.1	2.8	7.6	2.7
Eastern White Pine	17,918,165	6,143,081	4,262,651	10,405,732	1.7	2.9	4.2	1.4
Jack Pine	15,825,810	4,921,821	6,468,687	11,390,508	1.4	3.2	2.4	0.8
Lowland Hardwoods	47,781,350	22,492,477	9,729,340	32,221,817	1.5	2.1	4.9	2.3
N. Hardwoods	336,790,958	65,659,426	106,332,030	171,991,456	2.0	5.1	3.2	0.6
N. White Cedar	63,210,804	18,223,174	8,843,103	27,066,277	2.3	3.5	7.1	2.1
Oak Association	102,259,347	23,600,309	35,593,811	59,194,120	1.7	4.3	2.9	0.7
Other	50,379,435	12,217,305	43,658,218	55,875,523	0.9	4.1	1.2	0.3
Other Softwoods	13,689,768	2,661,175	1,632,679	4,293,854	3.2	5.1	8.4	1.6
Red Pine	98,362,980	8,496,913	23,377,993	31,874,906	3.1	11.6	4.2	0.4
Tamarack	7,572,606	1,482,076	1,802,507	3,284,583	2.3	5.1	4.2	0.8
White Spruce	11,072,824	1,254,013	2,246,652	3,500,665	3.2	8.8	4.9	0.6
Total	923,279,499	224,530,493	291,229,106	515,759,599	1.8	4.1	3.2	0.8

Note: Precise comparisons to older FIA reports are compounded due to changes in inventory methods and definitions and are not strictly valid.

III. Strategic Themes and Issues

The resource assessment for Michigan is organized by the three national themes:

- Conserve and Manage Working Forest Landscapes for Multiple Values and Uses;
- Protect Forests from Threats; and
- Enhance Public Benefits from Trees and Forests.

For each of these themes, the DNRE used a collaborative process to identify priority issues. The collaborative process was achieved through the engagement of existing DNRE advisory committees and other partner organizations, including the USFS, the USDA Natural Resource Conservation Service, and the USDI Fish and Wildlife Service. Michigan Native American tribes were invited, but did not participate in the collaborative process. A list of participating organizations is provided in Appendix A.

The discussion for each priority issue includes a description of the issue, including: the forest resource, public benefits derived from the forest resource; key attributes that are needed to produce the public benefits; direct threats to the public benefits and their contributing factors; opportunities for addressing key attributes; and geographic attributes to identify priority areas for addressing each priority issue.

The identification of priority areas was accomplished by a geospatial analysis that the DNRE conducted to produce maps for each priority issue. On the maps, these priority areas are broken into three classes: low, medium, and high-priority areas. Appendices B and C provide a detailed description of the spatial analysis process used in this assessment. It is anticipated that the priority areas identified in these maps will be used by DNRE cooperative forestry programs and their partner organizations to provide a basis for focusing program resources to address any particular priority issue, and to provide context and justification of grant application narratives.

The discussion of each priority issue concludes with the identification of strategies and resources to address each issue, and performance measures to assess progress toward accomplishing strategies.

A subset of Michigan's priority issues has been identified as multi-state issues, which are being addressed through one or more initiatives in common with one or more other states. Identified multi-state issues are:

- Promote sustainable active management of private forests;
- Maintain and restore aquatic ecosystems and watersheds;
- Reduce threats from invasive species, pests and disease;
- Reduce wildfire risk and improve public safety;
- Maintain markets for utilization of forest products;
- Maintain ecosystem services from private forestlands;
- Maintain forested ecosystems for biodiversity and wildlife habitat; and
- Maintain and enhance access to recreational activities on private forestlands.

A brief summary of initiatives for each multi-state issue and the state(s) involved are provided as part of that respective issue description.

Theme 1: Conserve and Manage Working Forest Landscapes for Multiple Values and Uses

Productive, intact and functional working forests are critical for maintaining a vibrant and sustainable forest products industry in Michigan. To help facilitate this, three issues are addressed for this theme:

- Promote sustainable active management of private forests;
- Reduce divestiture, parcelization, and conversion of private forestlands; and
- Reduce the high cost of owning private forestland.

Issue 1: Promote Sustainable Active Management of Private Forests

1. Issue Description

Private forests are subject to various treatments. If they are not sustainable, then there is a great risk of losing the forest system altogether. There are a range of activities or treatments that a forest system can sustain and still provide the functions of a healthy forest. By encouraging sustainable active management of our forests, it is believed that they will be better positioned to meet present and future needs. This type of management employs a land stewardship ethic that integrates the reforestation, managing, growing, nurturing, and harvesting of trees with the conservation of soil, air and water quality, biodiversity, wildlife and fish habitat, and visual qualities.

Most corporately-owned private forestlands are now certified for sustainable management by one of several international recognized forest certification systems, including the Forest Stewardship Council and the Sustainable Forestry Initiative. Some smaller private forestland holdings are also becoming certified for sustainable management with the American Tree Farm System.

This is a multi-state issue that is being addressed through several initiatives in cooperation with the States of Minnesota and Wisconsin, including:

a. The Great Lakes Forest Alliance's "Sustaining Working Forests Through Landowner Assistance and New Market Opportunities in the Upper Great Lakes Region of the U.S. and Canada"; and

b. Tri-State (MI, MN, WI) Forest Summit actions for:
   - Coordinated biomass harvest guidelines and coordinated comment on proposed federal legislation;
   - Coordinated comment on revisions to forest certification standards;
   - Developing a common policy for carbon offset protocols on public lands; and
   - Fostering a network of science professionals within the region to provide information about climate change adaptation to natural resource agencies.

- ***Forest Resource*** - Michigan has a diverse representation of forest communities, which due to human influences, have changed dramatically in the past and continue to change today. Most forests are second growth, and are still in the process of recovering from over-exploitation in the mid to late 19th Century. Approximately 61 percent of Michigan forest lands are under private ownership (USDA 2004).

- ***Public Benefit*** - The forests of Michigan provide many tangible public benefits, including forest products, wildlife habitat, water and air quality, and scenic features, as well as more intangible benefits of natural systems (such as recreational and spiritual needs).

- ***Key Attributes*** - Sustainable management of forestland is the primary attribute for long-term provision of the above benefits from private forestland. The establishment and execution of sound management objectives for productive forest systems is also a key attribute that is necessary for sustainable management of private forestland. Conserving working forest landscapes includes protecting the function of forest ecosystems through a landscape level approach, since some aspects of forest management (such as ecosystem services, and water quality) are best addressed at the landscape scale.

- ***Direct Threats*** - Threats to sustainable benefits include development pressures and fragmentation, which can involve conversions from a working forest to a backyard woodlot or home development. Fragmentation can affect functional processes at the landscape level and also threaten other elements such as wildlife species and watershed quality. Uncontrolled recreation, trespass, and runoff can threaten water quality. Native and non-native insects and

diseases can negatively impact forest productivity and sustainability. Regeneration is threatened by invasive species and localized overpopulation of deer.

- ***Contributing Factors*** - The disjunctive nature of different private property interests across a landscape make it difficult to effectively and consistently disseminate and implement principles of sustainable forest management across multiple ownerships. Although development pressures have temporarily eased with the recent down-turn in the overall economy, they are expected to exert great influence on the divesture of private forestland by current owners. Revenue cuts to law enforcement and non-resident ownership may facilitate trespass and recreational damage, especially from ORV-type vehicles, which in turn contributes to the divesture of these lands. Pressure from the hunting community may prevent measures to decrease the deer herd to levels that will not damage forest regeneration.

- ***Opportunities*** - Opportunities for improving sustainability include:
  - Utilizing cost share opportunities and partnerships to emphasize the importance of sustainably managing the forest land;
  - Creating regional groups that examine the landscape in which local forest owners exist and to make recommendations for forest management to professional plan writers and with landowners;
  - Best management practices for both water quality and for biomass production can be shared with professional plan writers and with landowners; and
  - Recommendations can be made for forest regeneration goals across landscapes.
  - Promotion of forest certification systems can improve sustainable management of private forests.

- ***Geographic Attributes*** - Priority areas for promoting the sustainable and active management of private forests are shown in Figure 3.1. The priority areas are heavily focused upon private forestlands (including Commercial Forest and Qualified Forest Property Tax enrolled lands), areas of high tax rates, and areas that are currently active with the Forest Stewardship Program.

2. Strategies

The following strategies are identified to address this issue:

- Use the Forest Stewardship and other assistance programs to provide information through outreach and education, seek cost share opportunities, and to work with partners to promote sustainable management of private forest land.

- Encourage the acquisition of conservation easements that enable the sustainable management of forest land.

- Inform the public and community decision makers about the importance of sustainable forest management, including the values provided to society by essential ecosystem services, forest products that contribute to jobs, wildlife habitat, water and air quality protections, scenic and beauty features, as well as the intangible benefits of natural systems (such as recreational and spiritual needs).

- Assess where wild cervid (deer, elk, etc.) numbers can be managed to assist in forest regeneration goals across landscapes.

3. Required Resources

The following DNRE resources are currently being used to address the above strategies:

- Forest Management Division, Forest Stewardship and Forest Legacy Program staff.

The following partners are needed to address the above strategies:

- USDA Natural Resource Conservation Service
- USDA Farm Service Agency
- Michigan Department of Agriculture
- Michigan State University Extension
- Conservation Districts
- The Nature Conservancy
- Other Land Conservancies
- Michigan Forest Association
- Michigan Forest Resource Alliance
- American Tree Farm System
- Professional Forest Stewardship plan writers

4. Performance Measures

The following performance measures will be used to assess progress in attaining strategies:

- Number of Forest Stewardship plans, or other landscape level plans.
- Number of conservation easements.
- Cost share acres utilized for purposes of tree planting and forest improvement.
- Number of outreach and training sessions held for professional plan writers and private forest landowners to provide information on plan writing, sustainable management, forest regeneration, endangered species/invasive species information.
- Assessment of browse impacts on forest regeneration.

Issue 2: Reduce Divestiture, Parcelization and Conversion of Private Forestlands

1. Issue Description

The maintenance of an intact land base of productive private forestland is threatened by a number of trends, including fragmentation and conversion to development and other non-forested uses, the intergenerational transfer of private forestland, reduced global competitiveness of vertically integrated forest product corporations, and localized commercial and residential development pressures.

- ***Forest Resource*** - Sixty-one percent of Michigan's forests are under private ownership. Most private non-industrial forestland is located in the Lower Peninsula, while most private-industrial forestland is located in the Upper Peninsula. Over half of private landowners own fewer than 10 acres, and collectively control only 7 percent of private forestland (USDA 2004). Corporations own and manage large tracts (thousands of acres) of private forestland, about 14 percent of total forestland. However, the types of corporations that hold these lands have been changing. Many vertically integrated corporations with large holdings of forestland have been divesting their lands to Timber Management Organizations (TIMOs) and Real Estate Investment Trusts (REITs), with higher value portions of some lands (especially water frontage) being sold for development.

- ***Public Benefit*** - Forests provide many critical benefits to society. These benefits include air quality, water quality, soil quality, wildlife habitat, reservoirs of biological diversity, places of beauty and solitude for human cultural and spiritual needs, as well as a source of wood products that supports a vibrant and sustainable forest products industry that is a significant part of the economy of Michigan and the United States.

- ***Key Attributes*** - Maintenance of a relatively intact and unfragmented land base that is primarily managed as productive forestland is a key attribute that is necessary to provide these public benefits.

- ***Direct Threats*** - Threats to the maintenance of an intact land base of productive forestland include fragmentation and conversion to development and other non-forested uses, the intergenerational transfer of private forestland, reduced global competiveness of vertically integrated forest product corporations (TIMOs and REITs), and localized commercial and residential development pressures. There was a net loss of about 114,000 acres of forestland over the decade between 1993 and 2004. Fifty-eight percent of the loss was due to development for urban areas or rights-of-way (USDA 2004). As part of the intergenerational transfer of forestland, older non-industrial forest owners may face economic pressures to convert their land to cash assets for retirement income and other expenses.

- ***Contributing Factors*** - Social trends in rural and ex-urban development (urban sprawl) contribute to making direct threats difficult to manage. Newer generational owners may not have the same attachment or long-term commitment to the forest resource as the current or past ownerships, and may seek to convert land to a cash asset, especially as a short-term solution for income in economically depressed areas. The globalization of markets has created disparities in relative competitive advantage of forestlands on regional, hemispheric and global scales. This can particularly be quantified in terms of climatic-driven growth rates, variations in the rate of return on capital investments, and production costs in terms of labor, taxes and environmental regulations.

- ***Opportunities*** - Opportunities for sustaining a land base of productive forestland include providing information and education materials to landowners and communities to facilitate and enable the transfer of forestland from one generation to the next. Conservation easements can help to retain some working forest land, and tax incentives such as the Commercial Forest and Qualified Forest Property Tax programs can also help to maintain a large base of private forestland. Newly emerging ecosystem service markets may provide future economic initiatives to forest owners to implement measures for retaining forestland.

- ***Geographic Attributes*** - Priority areas for addressing the divestiture, parcelization and conversion of private forestlands in Michigan are shown in Figure 3.2. Priority areas for providing incentives to private landowners to maintain forestland are shown in Figure 3.3. Priority is focused on larger patches of private forestlands that are subject to high tax rates and threat of development, particularly in proximity to Commercial Forest and Qualified Forest Property Tax enrolled lands and areas that are currently active with the Forest Stewardship program.

2. <u>Strategies</u>

   The following strategies are identified to address this issue:
   - Work with local units of government to encourage the retention of productive working forestland in a landscape level context.
   - Use the Forest Stewardship and other assistance programs to provide information and technical assistance to private forestland owners regarding methods and incentives for retaining their holdings as productive forestland.
   - Create appropriate outreach and education messages for urban and community audiences related to preserving private forestlands.
   - Focus programs for the acquisition of conservation easements on those areas of the state with the highest value of productive forestland which is threatened by development.
   - Facilitate forest land use training of local government officials through programs such as Michigan State University's "Citizen Planner" program.

- Work with private developers, community zoning officials, and land use planners to identify and preserve critical private forestlands at risk of fragmentation.

3. Required Resources
   The following DNRE resources are currently being used to address the above strategies:
   - Forest Management Division, Forest Stewardship, Forest Legacy, and Urban and Community Forestry Program staff

   The following partners are needed to address the above strategies:
   - Michigan State University Extension
   - Michigan Forest Stewardship Advisory Committee
   - Michigan Urban and Community Forestry Council
   - Local units of government
   - The Nature Conservancy
   - Other Land Conservancies

4. Performance Measures
   The following performance measures will be used to assess progress in attaining strategies:
   - The number of acres that are in private ownership and the number that have Forest Stewardship or other landscape-level plans.
   - The number of Forest Stewardship or other landscape-level plans completed and the number of acres covered by these plans.
   - The number and type of outreach efforts extended to landowners regarding issues such as intergenerational transfer and incentive programs. Included in this measure is the number of landowners reached.
   - Number of acres protected with Forest Legacy Program conservation easements or other conservation programs on an annual basis.
   - Number of local government officials receiving forest land use planning training.

Issue 3: Reduce the High Cost of Owning Private Forestland

1. Issue Description
   Several factors increase the cost of owning forestland. These include taxes, costs of management, and limited cost share assistance. Property taxes, capital gains taxes, inheritance taxes, and other costs are important issues, especially for those private forestland ownerships not enrolled in a property tax abatement program, or if the forestland is not eligible for the Homestead Property Tax credit. Other costs (such as improvement cuttings, wildlife habitat improvement, and forest regeneration) can be prohibitive, especially if not offset by cost share programs.

   - ***Forest Resource*** - Sixty-one percent of Michigan's forests are under individual, corporate, or non-corporate private ownership. Despite property tax reform in the 1990s, taxes are a significant component of the cost of owning private forestland. Statutes such as the Commercial Forest (CF) and the Qualified Forest Property Tax (QFP) Act (2006 PA 378 and PA 379) are designed in part to help reduce the cost of owning forestland by lowering the tax burden. Over 1.9 million acres of corporate forestland and over 308,000 acres of non-corporate forestland are enrolled in the CF Program, representing over 11 percent of Michigan forestland.

   - ***Public Benefit*** - Maintenance of a land base of private forestland provides benefits, such as a source of timber and other forest products, wildlife habitat, and ecosystem services derived from forestland.

   - ***Key Attributes*** - Maintenance of lands in a forest condition is critical for producing these public benefits.

- ***Direct Threats*** - Property taxes, capital gains taxes, inheritance taxes, and other costs are threats to maintaining a land base of private forestland. Many counties in northern Michigan do not have a diversified tax base with a high percentage of lands in public ownership, which do not contribute to the tax base at the same level as private lands. The DNRE provides payments in lieu of taxes for state-owned lands, which helps to off-set this disparity. Even so, in many northern Michigan counties, private lands effectively make a disproportionally greater part of the tax base. Without the protection of the tax abatement laws such as the CF or QFP programs or the Homestead Property Tax credit, some forest ownerships are taxed at rates that constitute a disincentive to maintaining a land base of private forestland.

  Costs for capital improvement for forestland (such as thinning and pruning, wildlife habitat improvement, and planting for forest regeneration) can be expensive, especially if not offset by cost share programs. Although there is limited cost share available for private forestland, these programs may have eligibility criteria that are difficult for some forest owners to meet.

  Owners who face large medical expenses may be faced with the need to divest all of their assets to pay these expenses. As retirement income falls behind the costs of living, there is additional pressure to convert forested properties to cash. Finally, inheritance taxes and inheritance laws that require large payments or splitting of assets add pressure to convert forestland to cash to meet those obligations.

- ***Contributing Factors*** - The economies of many northern counties are relatively undiversified, with a heavy reliance upon natural resource industries, tourism, and to a lesser extent, agriculture. Rural communities that rely on property taxes as a source of revenue, raise tax rates on absentee forest landowners who do not vote in their jurisdiction. Absentee forest owners do not get the property tax exemption of a primary homestead, and are taxed at higher rates than residents, if they are not enrolled under one of the tax acts.

  Commercial Forests have a requirement for public access that often conflicts with privacy values for private forestland, which is the third highest reason people own forestland in Michigan. This can be an impediment to enrolling smaller forestland parcels in the CF program. Current withdrawal penalties under tax law for Qualified Forest Property are substantial and are a detriment to those who consider enrollment. A withdrawal recapture tax has been proposed by the Non Industrial Private Forestland Coalition to redress this issue, but has not yet been enacted.

  Development is often perceived as being of more value to communities than the conservation of working forestlands, and local ordinances and property tax assessments often reflect that. There are limited statewide resources (such as the Forest Legacy Program) that enable the purchase of development rights for the maintenance of private forestland and open space. There are currently few fiscal state resources committed to the purchase of development rights. Most recent and active efforts at directing additional fiscal resources toward providing incentives for the purchase of development rights have occurred at the county and regional level.

  The rising cost of healthcare is a contributing factor, as people cite medical costs as a primary reason they are considering selling their forestland. In a recent survey, 37 percent of Wisconsin family forest owners found that the cost of medical care is a concern that would force them to convert or sell the family forest, ranking above concern for high taxes (31 percent) (Mater 2008).

- ***Opportunities*** - Opportunities to reduce the cost of owning forestland include conservation easements for working forestland, and other incentives such as the Commercial Forest and Qualified Forest Property Tax programs. Additional opportunities may arise through cost share opportunities for management practices.

- ***Geographic Attributes*** - Priority areas for reducing the high cost of owning private forestland are shown in Figure 3.4. These priorities are focused upon private forestlands subject to high tax rates and which are threatened by development.

2. Strategies

   The following strategies are identified to address this issue:
   - Seek to purchase conservation easements on forestland.
   - Encourage the enrollment of forestland in the Commercial Forest Program.
   - Seek an amendment to Recapture Tax Law that would encourage more forestland owners to enroll to the Qualified Forest Program.
   - Use the Forest Stewardship and other assistance programs to provide outreach and education materials, technical assistance, and cost share programs to private forest owners to reduce the costs of owning forestland.

3. Required Resources

   The following DNRE resources are currently being used to address the above strategies:
   - Forest Management Division, Forest Stewardship and Forest Legacy Program staff.

   The following partners are needed to address the above strategies:
   - Forest Stewardship Program State Advisory Committee
   - Natural Resource Conservation Service
   - Michigan Forest Association
   - Michigan State University Extension
   - American Tree Farm System
   - Non-Industrial Private Forestland Coalition
   - Conservation Districts
   - The Nature Conservancy
   - Other Land Conservancies

4. Performance Measures

   The following performance measures will be used to assess progress in attaining strategies:
   - Number of conservation easements held.
   - Number of new ownership enrolled in as Commercial Forest.
   - Number of new ownership enrolled as Qualified Forest.
   - Number of training sessions on intergenerational transfer.
   - Number of owners utilizing cost share programs to sustainably manage their forestland.

Theme 2: Protect Forests from Threats

Restoring and maintaining the health of both terrestrial and aquatic ecosystems is a priority on both public and private lands. Due to the interspersed patterns of public and private ownership in many landscapes of Michigan, strategies to address the following issues can only be effective if they are addressed across all ownerships. Four issues are addressed for this theme:

- Maintain and restore aquatic ecosystems and watersheds;
- Reduce threats from invasive species, pests and disease;
- Reduce wildfire risk and improve public safety; and
- Reduce the impact of recreational activities on forest resources.

Issue 1: Maintain and Restore Aquatic Ecosystems and Watersheds

1. Issue Description

Michigan maintains jurisdiction over approximately 45% (by surface area) of the four bordering Great Lakes (38,865 of a total area of 86,910 square miles). In addition to the Great Lakes, there are 46,000 (872,109 acres) inland lakes and reservoirs with a surface area greater than or equal to 0.1 acre and 76,439 miles of rivers, streams, and connecting channels (USGS NHD 1:24,000 scale) (LeSage and Smith 2010). Maintaining and restoring aquatic ecosystems that comprise watersheds is crucial for the health of the Great Lakes.

This is a multi-state issue that is being addressed through several initiatives in cooperation with one or all other Great Lakes states, including:

a. The Great Lakes - St. Lawrence Basin Water Resources Compact;
b. The Western Lake Erie Basin Partnership (with the State of Ohio);
c. The Great Lakes Restoration Initiative; and
d. The St. Joseph River Watershed Management Plan (with the State of Indiana)

- ***Forest Resource*** - Many watersheds throughout the state contain upland and lowland riparian forests and forested wetland communities. Forested watersheds and riparian areas containing trees, scrub/shrub communities, and native grasses are a neceassary component to the maintenance and restoration of functioning aquatic ecosystems and watersheds.

- ***Public Benefit*** - Riparian forests and forested wetlands protect aquatic ecosystems and watersheds, and produce and sustain high water quality and quantity through aquatic buffers. Buffers provide stable groundwater input and stream flow through natural runoff volume control by evapotranspiration and infiltration, stable stream channels, bank erosion and storm water control (Strayer 2003), stream shading, in-stream habitat, reduced sediment, and nutrient inputs (Baker et al. 2001), a variety of energy inputs (Vanotte et al. 1980), and organic material (Findlay et al. 2001). Riparian forests also provide recreation opportunities (including fishing, swimming, and boating), and maintain diverse, self-sustaining populations of fish and wildlife.

- ***Key Attributes*** - Healthy forests throughout watersheds (not just in riparian corridors) are also critical to healthy, stable, and productive aquatic ecosystems and watersheds. Changes to land cover alter the rate and volume of storm water reaching surface water and groundwater. Key attributes are maintaining the benefits derived from healthy and effective forests. These attributes include maintaining entire forested watersheds and imbedded riparian forests (which can in turn influence fish and wildlife communities (Naiman and Latterell 2005)), and protecting the free-flowing condition of a river (which can influence the ecologic integrity of the entire river system by affecting water quality and quantity, energy sources, physical habitat, and biotic interactions (Poff and Zimmerman, 2010; Poff et al. 1997)).

- ***Direct Threats*** - Threats affecting the health, stability and productivity of forests, riparian systems and associated aquatic ecosystems include development, destructive land use practices, and invasive species. Loss of terrestrial and riparian forests occurs through fragmentation and conversion of forests to other uses (agriculture, residential, commercial). Landscape scale land uses within a watershed (e.g., urban development or agriculture) alter natural hydrology and threaten or influence fish and wildlife habitat, and impact water quality from point and non-point source pollution (Allan 2004; Townsend 2003; Fausch et al. 2002). Poor logging and forest management practices, and invasive species (e.g., Dutch elm disease, emerald ash borer, and Asian long-horn beetle, reed canary grass, phragmities, etc.) also degrade aquatic ecosystems.

- ***Contributing Factors*** - Factors that contribute to the direct threats are trends in rural and ex-urban development that contribute to urban sprawl (land division, divestiture, and development into other uses), public unawareness of riparian forest values and benefits, and a lack of information or education concerning the negative resource impacts that land use changes or inappropriate timber management practices can have on hydrology, run-off pollution, and aquatic ecosystems.

- ***Opportunities*** - Opportunities for improving key attributes include:
  - Wide distribution and use of forest land best management practices, such as the DNRE Sustainable Soil and Water Quality Practices of Forest Land (Michigan Department of Natural Resources and Michigan Department of Environmental Quality 2009); the Guidebook of Best Management Practices for Michigan Watersheds (Michigan Department of Environmental Quality 1998 – in revision); the Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers (Southeast Michigan Council of Governments 2008); and Best Management Practices for the Use of Preservative-Treated Wood in Aquatic Environments in Michigan (Michigan Department of Natural Resources et al. 2002);
  - The cooperative development or implementation of existing integrated watershed assessments and restoration plans to help maintain and restore healthy, stable, and productive watersheds;
  - Implementation of existing state and local regulatory programs that protect watersheds and aquatic ecosystems;
  - Conservation easements and fee purchase of lands within identified critical corridors;
  - Expansion and implementation of private forest land certification programs;
  - Cooperative Forestry Assistance grants for urban forestry projects on brownfields within Areas of Concern for the Great Lakes, and to assess and protect urban and community forests;
  - Development of additional outreach products and opportunities;
  - Federal grants for implementation of water quality projects consistent with state-approved watershed management plans; and
  - Expanding forest/vegetated cover through tree planting programs.

- ***Geographic Attributes*** - Priority areas for the maintaining and restoring aquatic ecosystems and watersheds on both public and private lands in Michigan are shown in Figure 3.5. These priority areas focused upon wetlands, river corridors, areas of aquatic biodiversity, impaired watersheds, areas that greatly contribute to the production of clean water, and areas of high impervious surface.

2. Strategies

The following strategies are identified to address this issue:

- Utilize Michigan's Non-point Source Program to identify priority watersheds for assessment and restoration.
- Where watershed plans are not completed, partner with local units of government and watershed organizations to develop strategies to protect and restore priority watersheds.
- Share information about forested watersheds and their important role in water quality with watershed councils, other government agencies, municipalities, and landowners, so that forests are retained for this purpose.
- Focus urban forest planning, reforestation, and aforestation efforts where Water Resource Division (WRD) approved watershed plans are in place, or where local units of government have Municipal Separate Storm Sewer System (MS4) permits.
- Encourage the distribution, reference and use of the DNRE Sustainable Soil and Water Quality Practices of Forest Land (MDNR and DEQ 2009).
- Provide support to the Certified "Master" Logger Program.
- Support urban, ex-urban, and rural BMP demonstration projects.

- Seek opportunities to partner for implementation of Cooperative Forestry Assistance projects.
- Coordinate Michigan's Non-point Source Program Plan with organizations that are working to implement private forest land certification processes, to reduce or prevent non-point source erosion from private forest lands.
- Implement existing recommendations within Fisheries Division River Assessment reports and complete additional river assessments.
- Implement existing Natural River rules to protect aquatic ecosystems and designate additional Natural Rivers under authority of Part 305 of the NREPA, 1994 PA 451.
- Implement the applicable Priority Conservation Actions identified within the Michigan's Wildlife Action Plan.
- Prioritize the purchase conservation easements or fee ownership of riparian lands for the protection of watersheds or aquatic ecosystems.
- Implement current state wildlife grant strategies targeting the maintenance and restoration of aquatic ecosystems and watersheds.

3. Required Resources

The following DNRE resources are currently being used to address the above strategies:

- Forest Management Division, Forest Stewardship, Forest Legacy, and Urban and Community Forestry Program staff
- Fisheries Division, Natural River and biologist field staff
- Water Resource Division, Non-point Source staff
- Wildlife Division, WAP and Grants Program staff

The following partners are needed to address the above strategies:

- USDA, Natural Resources Conservation Service
- USDA, Forest Service
- Watershed Councils
- Michigan State Extension
- Michigan Forest Products Council
- Michigan SFI State Implementation Committee
- Michigan Forest Resource Alliance
- Michigan State University Extension
- Michigan Forest Association
- The Nature Conservancy
- Other Land Conservancies
- Local units of government

4. Performance Measures

The following performance measures will be used to assess progress in attaining strategies:

- Identification of DNRE WRD priority watersheds.
- Number of hard copies of Sustainable Soil and Water Quality Practices of Forest Land distributed, and the number of web hits for the on-line document.
- Number of certified loggers.
- Number of completed Forest Stewardship or other landowner assistance plans.
- Number of completed BMP demonstration projects.
- Number of urban forestry projects funded and implemented.
- The number of private forestland ownerships participating in forest certification programs.
- The number of river assessments or management plans implemented and the number of new assessments or plans developed.
- The number of permits issued under Part 305, Natural Rivers and/or the number of additional river designated within the Natural Rivers Program.
- The number of Wildlife Action Plan, Priority Conservation Actions implemented.

- The number of parcels or acres of riparian land protected by conservation easement or fee ownership.
- The number of completed state wildlife grant strategies targeting the maintenance and restoration of aquatic ecosystems and watersheds.

Issue 2: Reduce Threats from Invasive Species, Pests and Disease

1. Issue Description

Healthy and productive forests are comprised of a diversity of native tree, shrub, and herbaceous plant species, as well as an even larger number of faunal species for which forests provide habitat. Forested ecosystems have continuously adapted and evolved over thousands of years, as different insect, plant, and animal species are naturally, intentionally, or inadvertently introduced or extirpated from ecosystems. Prevention and mitigation of invasive species, pest, and disease introductions is important for the maintenance of healthy and productive forests.

This is a multi-state issue, where high threat invasive species are being addressed through in cooperation with other Great Lakes states, including the following initiatives:

a. Tri-State (MI, MN, WI) Forest Summit actions for coordinated response to the spread of Emerald Ash Borer and other invasive species, such as the Asian long horned beetle;
b. Cooperative Weed Management Areas.

- ***Forest Resource*** - There are 19.3 million acres of forestland in Michigan, covering about 53 percent of the state. Sixty-one percent (11.9 million acres) is privately-owned, and 38 percent (7.4 million acres) is managed by federal, state, and local governmental agencies (USDA 2004).

- ***Public Benefit*** - Healthy and productive forests provide many societal benefits, including timber and other forest products, wildlife habitat, recreational opportunities (e.g. camping, hiking, gathering, etc.), aesthetic values, and other ecosystem services (e.g. clean water and air).

- ***Key Attributes -*** Healthy forest systems contain complete assemblages of characteristic native insect, plant, and animal species, and intact and functional ecological processes that bind them together into complex systems are essential conditions for providing the above public benefits.

- ***Direct Threats*** - Invasive insect, plant, and animal species alter native species diversity, forest regeneration, and ecosystem functions.

- ***Contributing Factors*** - Contributing factors include the globalization of commerce (where invasive species can be transported in wooden packing materials), rapid means of transportation (which accelerates the inadvertent spread invasive species to new locations), and increased and diversified types of recreational activities (which can also provide a means of spreading invasive species).

- ***Opportunities*** - Opportunities for improving the integrity and health of forest resources include improved means of excluding new invasive species, improved monitoring protocols to detect the new incidences of invasive species, and identification of natural control mechanisms to combat established invasive species. Enhanced outreach and education can enlist the aid of the public in reducing the spread of invasive species.

- ***Geographic Attributes*** - Priority areas for reducing threats from invasive species, pests, and disease on both public and private lands in Michigan are shown in Figure 3.6. These are primarily focused upon areas of greater forest health risk, and proximity to roads, campgrounds, and recreational trails.

2. Strategies

The following strategies are adapted from "Meeting the Challenge of Invasive Plants: A Framework for Action", MNFI, March 9, 2009:

- Identify destructive agents, and evaluate their potential to cause damage or loss.
- Prevent the introduction and establishment of high-threat invasive insects, plants, and animal at state, regional, and local levels.
- Reduce the spread and harm caused by established invasive insects, plants, and animals.
- Manage forest pests through integrated methods, supplemented by direct control when necessary to prevent imminent damage.
- Provide information about forest health prevention and protection.

3. Required Resources

The following DNRE resources are currently being used to address the above strategies:

- Forest Management Division, Forest Stewardship, Forest Health, Inventory and Monitoring, and Urban and Community Forestry Program staff.

The following partners are needed to address the above strategies:

- Michigan Department of Agriculture, Pesticides and Plant Pest Management Division
- Michigan Technological University, Department of Forestry, School of Forest Resources and Environmental Science
- Michigan State University, Department of Forestry and Department of Entomology
- Michigan State University Extension
- USDA, Animal and Plant Health Inspection Service, Plant Protection and Quarantine Program
- USDA Forest Service, State and Private Forestry
- USDA Forest Service, Northern Research Station
- USDA, Natural Resources Conservation Service
- The Nature Conservancy

4. Performance Measures

The following performance measures will be used to assess progress in attaining strategies:

- Number of occurrences of new verified invasive species controlled or eradicated;
- Acres of land treated to eradicate an invasive forest insect, pathogen, animal, or plant.
- Acres of land risk-rated for invasive susceptibility (likelihood of an invasive becoming established) and invasive vulnerability (likelihood of an invasive causing tree mortality).
- Acres of state land with reduced risk of invasive impacts due to Early Detection/Rapid Response (EDRR) activities (ground and aerial detection surveys.
- Number of education sessions held for professional and public audiences.

Issue 3: Reduce Wildfire Risk and Improve Public Safety

1. Issue Description

Among portions of Michigan forestland are numerous urban communities that are at concurrent risk of wildfire, with 318 of them determined to be at the highest level of risk according to a 2008 assessment completed by the Department of Natural Resources and Environment (DNRE). The risk analysis for those communities indicates potential threat to homes, infrastructure, and natural or cultural resources impacting over 1 million people.

Many of these identified communities fall into what the DNRE calls a zone dispatch area. These identified areas are primarily made up of jack pine fuel types that have the greatest potential to spread rapidly and become large complex fires. The DNRE zone dispatch is a predetermined set of resources that will automatically respond to any fires within a designated boundary during specific high and above fire danger days. The DNRE needs to be able to maintain adequate trained

personnel and equipment to be able to respond to these threats to communities and forest resources.

This is a multi-state issue that is being addressed in cooperation with other Great Lakes states (MN and WI) through the Great Lakes Forest Fire Compact.

- ***Forest Resource*** - There are presently 19.3 million acres of forestland in Michigan, 18.7 million acres of which is productive timberland (USDA 2009). The landscape that some forestland communities occur upon and the natural characteristics of these communities have great influence upon the degree of wildfire risk. For example, the most fire-prone forestland in Michigan is dry northern jack pine forests, which occur upon expansive sandy glacial outwash plains in northern Michigan.

- ***Public Benefit*** - Forests provide a variety of societal benefits, including forest products, recreation, wildlife habitat, etc.

- ***Key Attributes*** - Key attributes for maintaining public benefits include forest that are in a productive and healthy condition, and properly equipped, trained, and effectively utilized wildland firefighting resources.

- ***Direct Threats*** - The threat of wildfires to forest resources in Michigan has been a problem for over a century. Recent Michigan wildfire seasons have seen an 18,000 acre, 7.5 million dollar wildfire in 2007. Another costly blaze in 2008 burned 1,300 acres, closed an interstate highway for 7 hours, and burned into the city of Grayling. During the spring of 2009 an 800-acre fire destroyed 22 homes and 50 other structures before being brought under control. Routinely, Michigan experiences complex fires threatening the wild lands, communities, its citizens, and their property. Complex wildfires are not the only issue; thousands of wildfires occur annually that do not threaten large tracts of timber but do pose a threat on a smaller scale to communities and personal property. When considered as a group, small blazes make up a large portion of the total acres burned and are responsible for much of the damaged personal property in any given year.

- ***Contributing Factors*** - Homes being constructed adjacent to wildlands has been a growing concern for decades. The wildland urban interface (WUI) has challenged traditional firefighting resources by increasing the difficulty of wildfire suppression by introducing structures into the complexity of managing an incident. The training, equipment, preparation and prevention effort that is now required to deal with the WUI issue have put a strain on local fire departments and the DNRE ability to always respond effectively and protect the public from a wildfire hazard. Yet the public still has an expectation they will be protected from these threats.

  Michigan's wildfire suppression force consists of a partnership of the Department of Natural Resources and Environment, the USDA Forest Service, and the many rural fire departments across the state. These local departments comprised of volunteers survive on very small budgets utilizing equipment that many times is not appropriate for wildfire suppression. The DNRE assists them by offering wildfire training and access to federal surplus property and small grants to upgrade the capabilities and apparatus of their rural departments. The Department of Natural Resources and Environment maintains a fleet of specialized mechanized equipment which we staff with highly-trained firefighters. These employees provide wildfire expertise to rural fire departments when complex wildfires occur and interact with them throughout the year coordinating training, communication, and other emergency management activities. In order to continue to effectively provide these services, DNRE personnel need to be stationed in identified high-risk locations across the state.

- ***Opportunities*** - Several mitigation efforts are in places which are designed to reduce the risk to communities and forest resources threatened by wildfires in Michigan. Hazardous fuel reduction treatments are used to establish wildfire breaks. Wildfire prevention education and outreach is part of a statewide effort to reduce the number of preventable wildfires. The national Firewise Communities program is a multi-agency effort designed to reach high risk communities by involving homeowners, community leaders, planners, developers, and others in the effort to protect people, property, and natural resources from the risk of wildland fire – before a fire starts. Communities most at risk from wildfires are encouraged to develop a community wildfire protection plans. Currently, funding for all of these wildfire mitigation programs relies entirely on our ability to secure federal grants.
- ***Geographic Attributes*** - Priority areas for reducing wildfire risk and increasing public safety in Michigan are shown in Figure 3.7. These areas are predominantly focused on wildfire risk, urban communities at risk, the wildland urban interface, and areas of high-population density and threat of development.

2. Strategies

   The following strategies are identified to address this issue:
   - Partner with other states to assist in protecting the public and forest resources of Michigan through the Great Lakes Forest Fire Compact, to provide advanced fire training to employees, develop, and produce wildfire prevention materials, augment our suppression capabilities with Compact resources, and develop technical improvement that will improve preparedness planning and prediction of daily fire risk.
   - Partner with the Michigan Interagency Wildfire Protection Association to enable federal, state, and local wildfire agency coordination of pre-suppression planning of communication, contact information, equipment availability, aerial detection, and wildfire prevention efforts including media interaction and development of prevention products.
   - Partner with Michigan State University Extension to deliver the Firewise message across fire prone landscapes in Michigan.
   - Seek grants opportunities for:
     - Mitigating wildfire risk, including reducing hazardous fuels, preventing unintended wildfire ignitions, Firewise education, and developing Community Wildfire Protection Plans.
     - Enhancing wildfire suppression capabilities by improving the outfitting, training, and communication with local fire departments, including screening and acquisition of excess military equipment, and funding to train and outfit DNRE employees to national standards outlined by the National Wildfire Coordinating Group 310-1 guidelines.
     - Utilizing new technology to enhance ability to plan for wildfire suppression, predict fire behavior and manage the wildfire program in Michigan.

3. Required Resources

   The following DNRE resources are currently being used to address the above strategies:
   - Forest Management Division, Resource Protection program staff

   The following partners are needed to address the above strategies:
   - States in the Great Lakes Forest Fire Compact
   - Michigan Interagency Wildfire Protection Association
   - Michigan State University Extension
   - USDA, Forest Service
   - Urban Communities at risk

4. Performance Measures

   The following performance measures will be used to assess progress in attaining strategies:
   - Number of partnerships.
   - Number of cooperative agreements with local fire departments.
   - Completion of an updated statewide fire management plan.

Issue 4: Reduce the Impact of Recreational Activities on Forest Resources

1. Issue Description

   Recreation is an important use of forest resources. However, over use of dedicated recreational resources and illegal recreation uses can have an adverse impact (e.g. erosion, degradation of habitat, etc.) upon the recreational infrastructure itself and the surrounding forest resources.

   - ***Forest Resource*** - Michigan's forests provide the largest public land base for outdoor recreation east of the Mississippi River, and most forest recreation occurs on public land. Within the 3.9 million acres of state forest system there are approximately 140 designated campgrounds, 116 designated water access sites, 485 undeveloped water access sites, 880 miles of non-motorized pathways, 2,500 miles of designated off-road vehicle (ORV) trails, and 1,500 miles of designated snowmobile trails to facilitate outdoor recreation. In addition, over 8,000 miles of forest roads provide access for dispersed recreation enthusiasts such as hunters, wildlife viewers, anglers, and those who pick wild edibles or enjoy non-programmed nature appreciation.

   - ***Public Benefit*** – Forest recreation is an important asset**,** meeting public health and recreation needs. It provides a positive image for visitors to Michigan state forests, and supports a vibrant and sustainable natural resource based tourism industry.

   - ***Key Attributes*** - A well planned, dedicated, and maintained forest recreation system is a key attribute necessary to support a viable and sustainable recreation and tourism industry.

   - ***Direct Threats*** - Threats to the development, maintenance, and enhancement of the forest recreation system include an aging infrastructure, unmanaged dispersed camping and equestrian use, illegal ORV use, and declining budgets to support, maintain, and grow forest recreation programs.

   - ***Contributing Factors*** - The recent recession and high unemployment in Michigan has resulted in decreased use participation, and a commensurate reduction in the revenue streams that support forest recreation programs. In addition, loss of general fund support for forest recreation programs, the opening of county roads in northern Michigan to ORV use, and a new unfunded mandate to designate an equestrian trail system contribute to making direct threats difficult to manage.

   - ***Opportunities*** - There are opportunities to acquire, develop, maintain, and renovate rustic forest recreation facilities, include utilizing and prioritizing use of existing user pay funding sources, securing new funding sources, and fostering partnerships to support and enhance forest recreation facilities.

   - ***Geographic Attributes*** - Priority areas for reducing impacts of recreational activities on forest resources in Michigan are illustrated in Figure 3.8. These areas are focused upon public lands, recreational trails, campgrounds, and fishing access sites, areas with records of resource damage, and areas of high road density.

2. Strategies

   Strategies for addressing this issue will be accomplished by implementing select key initiatives of Michigan's 2008-12 Statewide Outdoor Comprehensive Recreation Plan (SCORP). The full 2008-12 SCORP is available on the DNRE Website at: http://www.michigan.gov/dnr/0,1607,7-153-10366_37984-176508--,00.html

Key SCORP priorities and initiatives relating to this issue include:

- Protect, restore and enhance natural resources quality related to public outdoor recreation, including land acquisition for outdoor recreation, wetlands protection and restoration, restoration of ORV damage, and conservation education.
- Expansion and securing of dedicated non-motorized and motorized land- and water-based trails, including water access for non-motorized and motorized craft.
- Providing universal access to outdoor recreation, including development and renovation of recreation infrastructure to facilitate universal access.
- Provide a quality and integrated state forest recreation infrastructure, including improvement and renovation to protect environmental quality and provide access.
- Incorporate green technology in the design, development and renovation of outdoor recreational opportunities, including energy saving, environmentally friendly, and cost efficient alternatives to past infrastructure construction and maintenance practices.

3. Required Resources

The following DNRE resources are currently being used to address the above strategies:

- Forest Management Division, Recreation and Trails Section program staff
- Forest Management Division, Forest Stewardship Program staff
- Recreation Division

The following partners are needed to address the above strategies:

- Michigan Snowmobile and Trails Advisory Council
- Forest Management Advisory Committee
- Citizens Committee for Michigan State Parks
- Conservation Districts
- The Michigan Trails and Greenways Alliance
- Michigan Snowmobile Association
- Cycle Conservation Club of Michigan
- Michigan Recreation and Parks Association
- Michigan Mountain Bike Association
- Michigan Horse Council

4. Performance Measures

The following performance measures will be used to assess progress in attaining strategies:

- Number of acres acquired for outdoor recreation, wetland protection and restoration, and conservation education.
- Number of miles of dedicated and maintained developed motorized and non-motorized land and water trails.
- Number of campground, trail, and water access site infrastructure development and renovation projects.
- Number of facility infrastructure upgrades using green technology and adaptation to accommodate universal access.
- Number of ORV damage sites restored.

Theme 3: Enhance Public Benefits from Trees and Forests

There are many tangible and non-tangible public benefits that are derived from both rural and urban trees and forests. These include forest products, ecosystem services, quality of life, scenic qualitities, biodiversity and wildlife habitat, and recreation. Nine issues are addressed for this theme:

- Maintain markets for utilization of forest products;
- Maintain ecosystem services from private forestlands;
- Provide effective conservation outreach for private forestlands;

- Build local community capacity to manage urban forest resources;
- Maintain community quality of life and economic resiliency;
- Maintain and enhance scenic and cultural quality on private forestland;
- Maintain forested ecosystems for biodiversity and wildlife habitat;
- Maintain, and enhance access to recreational activities on private forestlands; and
- Reforestation of urban and ex-urban areas.

Issue 1: Maintain Markets for Utilization of Forest Products

1. Issue Description
   Maintaining markets for forest products are an important component of local economies throughout much of Michigan.

   This is a multi-state issue that is being addressed through several initiatives in cooperation with other Great Lake states, including:

   a. The Great Lakes Forest Alliance's "Sustaining Working Forests Through Landowner Assistance and New Market Opportunities in the Upper Great Lakes Region of the U.S. and Canada";
   b. Urban wood utilization and product branding for urban wood products (Illinois, Michigan, and Wisconsin); and
   c. Tri-State (MI, MN, and WI) Forest Summit actions for:
      - Coordinated biomass harvest guidelines and coordinated comment on proposed federal legislation;
      - Coordination on the location and development of bio-energy (including ethanol, co-generation of electricity and steam, and wood pellet/briquette production) projects; and
      - Developing a common policy for carbon offset protocols on public lands.

   - ***Forest Resource*** - Michigan's forest resources provide the foundation of forest products markets which drive the local economies throughout much of Michigan. This forest resource includes one of the largest amounts of growth in excess of removals in the nation and probably the greatest amount of any state in the eastern U.S. While the resource is particularly central to the local economies in the more rural northern two-thirds of the state, many secondary manufacturing establishments are rooted in the forest products sector in the Southern Lower Peninsula as well.

   - ***Public Benefit*** - Forest product markets provide numerous public benefits in addition to good-paying jobs; from provision of habitat through enabling the existence of community infrastructure and quality of life. In many situations, the value of forest products derived from our forests allows sustainable forest management options to be implemented on the ground. Lack of forest products markets can severely limit management options and require significant public investments to accomplish forest management activities.

   - ***Key Attributes*** - The following are critical influences on maintaining Michigan's forest product markets. They include infrastructure, a diversity of products and markets, recruitment and investment, institutional support, permitting, and public support.

     Infrastructure is required to transport products throughout the supply and production chain. A diversity of products and markets are important to enable firms to profitably take advantage of the diversity of tree species and mixed products which are harvested in Michigan's forests. The importance of this diversity is likely to increase as our forests continue to mature and many of them are managed to achieve more mixed stands.

     Similarly, it is important that recruitment and investments occur from the logging operation through the various stages of wood product manufacturing. One concern in particular is the loss

of logging capacity as this sector has become more capital intensive and market downturns have led to fewer firms. There has also been concern expressed about fast-changing markets as oil prices have widely fluctuated, energy subsidy programs have changed incentives and fostered more attention on the use of biomass for energy.

Institutional support in academia and government is important for the maintenance of markets. Such support influences sound policies and regulations, for example in the area of permitting. Research and development, and extension activities promote keeping up with new technology and information.

Public support also continues to be an ongoing concern for wood fiber production. Familiarity and acceptance of resource-extractive economic sectors and activities is important especially as society becomes predominantly more urban (and suburban), economies are more service-oriented, people become more removed from rural extractive industries, and ecological concerns such as habitat loss and climate change become more pervasive.

- ***Direct Threats*** - Some threats relate to the lack, loss, or decline in key attributes, such as institutional and public support. Budget concerns are driving some loss of institutional resources. Other threats include biotic and abiotic factors that impact forest health. The globalization of markets reduces the influences over decision making at the more local and state levels. New and emerging bioenergy policies and guidelines may similarly disrupt existing markets and have unintended consequences.

- ***Contributing Factors*** - The current economic downturn has generated a tightening of budgets in both the public and private sectors. Wood product markets will continue to be influenced by international trade (and the changes in global market influences by such countries as China and India) and changes in the strength of the U.S. dollar, which in turn may be influenced by federal deficits. There are also many new standards, codes, and influences on wood product markets. These range from forest management certification protocols, new building codes, carbon markets, and lifecycle analysis evaluations of wood products, to additional environmental permitting requirements.

- ***Opportunities*** - These may be viewed in the context of forest resources, institutions, and emerging markets. The forest resource offers many opportunities. Broadly, a diversity of species and seral stages generates a very wide range of product opportunities. The demand for low end wood fiber (which will be the hallmark of bioenergy endeavors) can enable timber stand improvement (TSI) work that, in turn, generates higher value sawlogs and veneer products. The high level of commercial growth in excess of removals indicates that there are resources available that are not committed to other uses. Aspen is an example of a major forest resource which has a very large acreage approaching maturity. It already is used in a broad range of products, from paper through composite wood panels. It is also being targeted for fueling expanding bioenergy markets.

  A sluggish economy provides incentives for adapting new procedures. Combined with an array of governmental subsidies, there are many new assessments for utilization of Michigan's large amount of biomass, from biorefineries with existing infrastructure, through new cellulosic ethanol facilities, to re-use of urban waste and salvaging of pest-damaged trees.

  While many of these efforts are singular, stand alone projects, there are people thinking about and looking into combined heat and power applications for both businesses and communities. Others are working on developing the institutional frameworks necessary to enable these to occur, through collaborative planning, promulgating guidelines, and establishing the basis for more wood utilization.

- ***Geographic Attributes*** - Priority areas for maintaining markets for the utilization of forest products are shown in Figure 3.9. These priorities are heavily influenced by the areas where forest products industry is a greater part of the economy. Other specific areas of concern which can not be portrayed in a gross statewide map of the state as a whole include:
  - o Areas with community wildfire protection plans;
  - o Areas with forest health concerns;
  - o Areas impacted by storm events;
  - o Areas with existing industrial, commercial, or community infrastructure that provides opportunities for new energy markets; and
  - o Areas where land management decisions indicate that significant forest resources are available over the next 10-15 years.

2. Strategies

The following strategies are identified to address this issue:

- Continue to pursue and support greater collaboration across agencies and stakeholders (some of the examples fostered in recent years include the Forest Management Advisory Council, the Great Lakes Forestry Alliance, the Tri-State Summit (MI, MN, and WI), the development of woody biomass harvesting guidelines, and a Soil and Water Quality Guidelines manual).
- Continue to support and facilitate participation in hands-on training and/or demonstration of new techniques or practices which facilitate sound, sustainable utilization of wood fiber.
- Continue to support and communicate assessments of current and projected wood fiber utilization and market projections, and resolution of concerns regarding utilization.
- Support forest certification standards.
- Continue to be involved in energy-related policy and economic development efforts. This includes the need to address wood availability concerns through understanding broader energy market and energy efficiency concerns.
- Encourage the development of ecosystem services markets through grants, an ecosystem services bank, or partnerships.

3. Required Resources

The following DNRE resources are currently being used to address the above strategies:

- Forest Management Division, State Forester, Forest Products Specialist, and Forest Stewardship Program staff

The following partners are needed to address the above strategies:

- Michigan Department of Labor and Economic Growth
- Michigan Economic Development Corporation
- Forest Management Advisory Council
- The Great Lakes Forestry Alliance
- Great Lakes Timber Professionals Association
- Lake States Lumber Association
- Biomass Power Association
- Michigan Biomass
- Michigan Forest Products Council
- Michigan Association of Timbermen
- Other Tri-State Summit States (MN, and WI)

4. Performance Measures

The following performance measures will be used to assess progress in attaining strategies:

- The volume of timber product outputs or removals, by product type.
- Continued increases in the growth to removal ratio, in both absolute and percentage terms.
- Number of hours participating in or working with public/private projects, work groups, and associations, including training events and conferences.

- Incorporation of fiber utilization into government forestry plans.
- Number of wood energy thermal and cogeneration systems installed.
- Value added by manufacturing on a statewide basis, as reported in economic census reports.

Issue 2: Maintain Ecosystem Services from Private Forestlands

1. Issue Description

   Forests provide many ecosystem services, which include: the improvement of air quality by the sequestration of carbon and filtering air bound particulates; the improvement of water quality by curtailing sedimentation of water bodies, by providing shade to control temperature fluctuations, by providing stabilization of banks, by slowing the flow of rainfall to curtail erosion, and by sequestering some water-bound pollution; by providing habitat for common, threatened and endangered plant species; by holding and enhancing soil quality; by providing genetic resources for future forest generations; and by providing wildlife habitat for game and non-game wildlife species.

   This is a multi-state issue for carbon sequestration that is being addressed with the State of Illinois in partnership with the Delta Institute through the Working Forest Carbon Offset project.

   - ***Forest Resource*** - Ecosystem services are provided by all forests in Michigan, including 11.9 million acres of private forest land and 7.4 million acres of public forestland (USDA 2004).

   - ***Public Benefit*** - Public benefits from forests are cleaner water, cleaner air, less soil erosion, less sound pollution, provision of a home for common, threatened and endangered species, and a place of natural solitude.

   - ***Key Attributes*** - Healthy, stable, naturally functioning, and productive forest ecosystems are key attributes for ensuring the provision of ecosystem services for the public.

   - ***Direct Threats*** - Ecosystem services are currently enjoyed by all of society, but are often paid for only a small segment of society. The public is often unaware of the value of these services and may be reluctant to pay for them, especially when there is an expectation that they have historically been provided for free. From the perspective of many forest landowners, the notion that they must provide for or not take actions that could impair ecosystem services that are derived from their forestland without due compensation is an equally valid issue.

   - ***Contributing Factors -*** There are few efforts to provide private forestland owners with payments for the ecosystem services provided by their forest land, which is compounded by a lack of understanding of the nature of potential markets for these services and how to participate in them. There is no legislation that defines, quantifies, mandates, or regulates markets for ecosystem services. There are few initiatives, such as the Working Forest Carbon Offset project with the Delta Institute, that offer real gains to landowners (through incentive contracts) to provide ecosystem services. Moreover, some private contracts being offered to non-industrial private forestland owners may be using ecosystem service markets to entice landowners to sign away other rights.

   - ***Opportunities*** - There is an opportunity to expand participation in the Working Forest Carbon Offset project with the Delta Institute.

   - ***Geographic Attributes*** - Priority areas for maintaining ecosystem services from private Michigan forestlands are illustrated in Figure 3.10. These priority areas are focused upon areas of high groundwater re-charge, ability to produce clean water and sequester carbon, wetlands, large forest patches, and that support threatened and endangered species and natural communities.

2. Strategies

The following strategies are identified to address this issue:

- Promote the development of new ecosystem service markets through grants, an ecosystem services bank, or partnerships to provide economic incentives to private forest owners for the sustainable long-term management of their forest land.
- Encourage understanding, appreciation, and participation in ecosystem services markets.
- Promote the retention and expansion of urban tree cover to improve air and water quality, reduce storm water runoff and mitigate the impacts of urban heat islands.

3. Required Resources

The following DNRE resources are currently being used to address the above strategies:

- Forest Management Division, Forest Stewardship and Urban and Community Forestry program staff
- Water Resource Division, Non-Point Source program staff

The following partners are needed to address the above strategies:

- USDA Natural Resources Conservation Service
- USDA Farm Service Agency
- Michigan Department of Agriculture
- Michigan State University Extension
- Conservation Districts
- Resource Conservation and Development Districts
- Watershed Councils
- Delta Institute
- Local units of government

4. Performance Measures

The following performance measures will be used to assess progress in attaining strategies:

- Number of private forestland owners who participate in the Michigan Forest Carbon Offset and Trading Program or other reputable ecosystem service markets.
- Number of markets for ecosystem services.

Issue 3: Provide Effective Conservation Outreach for Private Forestlands

1. Issue Description

Effective conservation outreach requires both a clear, targeted message, and a well-coordinated delivery system. Michigan contains several agencies and organizations that promote conservation outreach as part of their missions. Each approaches their efforts in different venues, formats, topic areas and spatial scales. Despite the fragmented nature of these efforts, conservation activities continue to be an important way for both citizens and resource professionals to demonstrate collective responsibility for Michigan's lands.

- ***Forest Resource*** - Private forest owners control over 61 percent of Michigan's forestland. Few of the over 400,000 non-industrial owners understand the array of the state's forest resources and corresponding ecosystem services. Michigan lacks effective outreach to these owners that would provide them with sound information about the resources they own, and the range of sustainable management choices that are available. The resulting knowledge from such information can be used to enable informed decisions about their property for long-term sustainability.

- ***Public Benefit*** - Various studies suggest that citizens of the state, regardless of whether they own forested land, consider Michigan's forests to be a critical feature of the landscape. Beyond the traditional economic benefits of the forest products industry, citizens value these forests for various recreation activities, aesthetic, environmental, and spiritual values, and as critical habitat

for various wildlife species. Residents also value forests and conservation activities to gain a connection and sense of heritage with the land and instill a work ethic in their children (McDonough et al. 1999).

- ***Key Attributes*** - The forest resource contains a diversity of ecosystems across the state. Each human demand on the resource carries its own set of habitat/species mix requirements. Citizens must have reasonable access to these ecosystems in order to form positive attitudes toward natural processes in general, and conservation practices in particular.

- ***Direct Threats*** - Threats to a diverse, healthy and sustainable forest resource include a lack of long-term planning and unsustainable management, which can stem from unsustainable harvesting practices, ignorance, and benign neglect. Since most forest landowners value their land primarily for aesthetic and recreational purposes, they do not consider active forest management planning to be important. "Letting nature take its course" is the popular description of this ownership style, which ignores direct and indirect human influences on the quality and condition of the forest itself. For instance, the spread of disease and invasive species such as oak wilt and the emerald ash borer through the transport of firewood can have great influence on the quality and condition of the forest. When active management does occur, it can be in the form of unplanned harvests when approached by a logger or in response to financial hardship. These unplanned harvests can result in long-term damage to the resource through potential high-grading of the forest.

- ***Contributing Factors*** - There is an overall disconnect between what forest landowners value and what is required to achieve those values. A majority of landowners do not understand the value of long-term planning, sustainable harvesting practices, and other management activities in meeting their goals. Landowners are also generally unaware of the connections between the wildlife species they desire and the corresponding habitat that those species require. This lack of awareness may be compounded by popular attitudes against any type of forest harvesting. Any of these disconnects may be especially problematic when the forest land is owned by seasonal or nonresident (weekend/holiday) owners, who are less able to monitor changes or potential threats during occasional visits to their forested land.

- ***Opportunities*** - Forest landowners generally value their land as part of their home and/or a place to get away from hectic lives. Taking advantage of that personal connection to the land and the wildlife it supports is an effective means to share information on the value of conservation practices. Children and youth are also important audiences for conservation education. Outdoor experiences at young ages significantly influence positive attitudes toward conservation and natural resources in adult life. Specific opportunities include:
  - Non-Industrial Private Forestland (NIPF) Coalition: A network of agencies and organizations who serve private forest landowners coordinates planning meetings, occasional events, and educational materials for landowners and decision makers.
  - Local/regional outreach activities: Conservation districts, Resource Conservation and Development Districts (RC&Ds), watershed councils, etc. routinely offer conservation education and outreach for the residents in their coverage area, often based on the assessed needs of that particular location.
  - Statewide initiatives: Michigan State University Extension (MSUE), Michigan Department of Natural Resources and Environment, and other statewide organizations offer conservation programs via workshops, grants, bulletins and activities at locations such as state parks.
  - Youth education: MSUE maintains a vigorous youth conservation program through 4-H, while many nature centers and state parks target local youth to educate them on natural resources and basic conservation practices. Department of Natural Resources and Environment also maintains the Project Learning Tree program.
  - Logger education: The Sustainable Forestry Education (SFE) program is provided by the Michigan State Implementing Committee (SIC) for the Sustainable Forest Initiative (SFI)

program through its SFE subcommittee. It is administered by the Michigan Forest Products Council (MFPC) and is funded by member company assessments. MSUE is one of several entities that provide logger education and training under the SFE program.

- ***Geographic Attributes*** - Priority areas for providing effective conservation outreach for private Michigan forestlands are illustrated in Figure 3.11. These priority areas are focused upon private forestlands and recreational infrastructure (such as campgrounds, boating access sites, and trails) as vectors for the spread of disease and invasive species.

2. Strategies

The following strategies are identified to address this issue:

- Identify and clarify a common set of goals and desired outcomes associated with conservation outreach for various targeted audiences: youth, forest landowners, and resource professionals (including loggers).
- Examine initiatives and programs in other states and regions that successfully demonstrate effective conservation outreach.
- Develop a web and media presence (including social media) on current conservation issues and opportunities.
- Conduct education outreach regarding non-point source pollution prevention for loggers, professionals, and landowners.

3. Required Resources

The following DNRE resources are currently being used to address the above strategies:

- Forest Management Division, Forest Stewardship Program staff
- Wildlife Division, Private Lands Program staff
- Water Resource Division, Non-Point Source program staff

The following partners are needed to address the above strategies:

- Michigan State University Extension
- Non-Industrial Private Forestland Coalition
- Conservation Districts
- Resource Conservation and Development Districts
- Watershed Councils

4. Performance Measures

The following performance measures will be used to assess progress in attaining strategies:

- Number of conservation outreach materials produced.
- Number of landowners and professionals who receive conservation outreach materials.
- Number of articles and news releases posted.
- Number of hits/views on electronic media sites.
- Workshop-days offered on various conservation topics.
- Number and type of participants in workshops.

Issue 4: Build Local Community Capacity to Manage Urban Forest Resources

1. Issue Description

In the face of the current economic recession, communities throughout Michigan, and across the nation, are struggling to maintain public services at even basic levels. Not surprisingly, community tree maintenance programs have been drastically cut or eliminated at a time when there is a greater need than ever to address the impacts of issues such as the Emerald Ash Borer (EAB). Furthermore, with increasingly stringent environmental standards for clean air, and water, there is great need to focus on sustained management of green resources to provide the maximum benefits, environmentally, economically, and socially.

- ***Forest Resource*** - Urban and community trees and forests exist throughout the state but only approximately 10 percent exist as publicly-owned and managed resources. This presents many challenges in how they are managed for the public benefit since local communities are highly diverse in their approach and ability to manage this resource. Urban and community forests (UCF) are important for human and ecological health (Nowak and Dwyer 2007). The benefits attributed to urban and community trees are well documented. As of 2000, urban or community land in Michigan comprised over 7 percent of the land area and contains an estimated 107.8 million trees, of which an estimated 1.5 million are urban street trees. The average tree canopy cover in urban or community areas of Michigan is approximately 21 percent, with more than 24 percent impervious surface cover and almost 28 percent of the total green space covered by tree canopy cover (*Nowak and Greenfield 2010*).

  Urban trees are variable in size, species, condition, and location within urban and community areas. While detailed information may exist for individual trees on public lands, it may be outdated and is localized. Little data are available that describe this resource at a large, statewide scale or even the collective management of publicly-owned trees, which represents only 10 percent of the urban forest.

- ***Public Benefit*** - Urban and community trees provide a variety of benefits that contribute to improved air and water quality, aesthetics, and quality of life for those who live, work, and recreate in urban areas (Dwyer et. al. 1992). Michigan's urban and community forests are estimated to store about 20.6 million metric tons of carbon (valued at $469.7 million), and annually remove about 678,000 metric tons of carbon (valued at $15.5 million) and 14,820 metric tons of air pollution (valued at $121.7 million) (Nowak and Greenfield 2010). Additionally, trees in urban environments provide numerous other benefits including wildlife habitat, improved property values, (Morales et al. 1976), and contribute to improved storm water management.

  To ensure the maximum public benefits are achieved from these resources, local units of government (cities, villages, and townships, etc.) are entrusted with their management at the local level. The level of management provided is highly variable from non-existent to highly proactive. This depends greatly on the attributes of the community socially, economically, ecologically, and politically.

- ***Key Attributes*** - Several conditions/attributes are critical for producing the greatest public benefits from urban and community trees, including:
  - Continued expansion and reforestation of urban and community areas;
  - Maintenance of healthy and diverse urban trees and forests;
  - Sustained management of trees on public properties;
  - Public education and awareness of the role and benefits that trees provide; and
  - Local public policies to support urban forest establishment, maintenance and management.

- ***Direct Threats*** - Urban and community tree management efforts are continually hampered by several specific problems, including:
  - Loss of trees due to insect/disease threats, storm damage, development, etc.;
  - Insufficient local funding to support proper management of public trees;
  - Insufficient staffing of trained professionals to manage public trees;
  - Lack of current resource inventories and/or management plans; and
  - Lack of public involvement/advocacy to support management of local tree resources.
- ***Contributing Factors*** - There are numerous factors which may affect the relative severity of these direct threats, including:
  - General lack of awareness about the role of trees and forests in people's lives;
  - Lack of public policies (or enforcement) related to urban and community trees;
  - Uninformed decision making in the absence of sufficient resource inventory;
  - Lack of long-term management objectives or commitment to implementation of plans; and
  - Diminished opportunities for formal education training and careers in UCF.
- ***Opportunities*** - Opportunities are available to enhance key attributes and the condition of the urban and community forest resource. Some are of a technical nature and based on resource management issues while others are targeted at social, political, or economic issues. Possible opportunities include:
  - New techniques/tools available for management/assessment of the urban and community forest (e.g. urban tree canopy [UTC], CITYgreen and/or i-TREE analysis);
  - Science-based research concerning a variety of urban forest management and arboricultural issues;
  - Volunteerism to support tree planting, maintenance, and general advocacy of urban and community trees;
  - Legislative awareness to inform elected officials on UCF issues;
  - Provision of examples and reference materials of UCF topics to public and professionals in industry;
  - Facilitation and collaboration with partners to host UCF related workshops, seminars, training, etc.; and
  - Promotion of the Tree City USA programs for communities.
- ***Geographic Attributes*** - The state UCF program, through annual monitoring and reporting to U.S. Forest Service, tracks the level of management for each individual community, as defined by their Community Accomplishment and Reporting System (CARS). Communities are either defined as "Managing" or "Developing". "Managing" communities are considered to be self-sustaining whereas "Developing" communities need assistance or resources to achieve the "Managing" level. Figure 3.12 depicts the current extent of both "Managing" and "Developing" communities in Michigan as of 2009. Priority areas are those classified as "Developing".

2. Strategies

   The following strategies are identified to address this issue:
   - Target distribution of state UCF assistance to "Developing" communities to help them achieve Managing status in CARS.
   - Pursue funding opportunities, partners, programs that will support enhanced management of urban and community trees.
   - Promote locally successful examples of effective UCF management techniques, programs, and partnerships etc.

3. Required Resources

   The following DNRE resources are currently being used to address the above strategies:
   - Forest Management Division, Urban and Community Forestry Program staff
   - Forest Management Division, Resource Assessment Unit staff

The following partners are needed to address the above strategies:

- National Association of State Foresters and Northeastern Area Association of State Foresters
- National Urban and Community Forestry Advisory Council
- Michigan Urban and Community Forestry Council
- USDA, Forest Service, State and Private Forestry programs and research stations
- The Greening of Detroit
- Global ReLeaf of Michigan
- Michigan State University Extension
- Arbor Day Foundation
- Arboriculture Society of Michigan
- Michigan Arbor Day Alliance
- Local units of government

4. Performance Measures

The following performance measures will be used to assess progress in attaining strategies:

- Number of communities assisted and moving from "Developing" to "Managing" status.
- Population of communities in "Developing" or "Managing" status.
- Amount of funding distributed to communities in "Developing" status.
- Number of grants issued to communities in "Developing" status.
- Number of communities initiating a new or initial tree ordinances, inventories, management plans, tree boards, or employment of professional UCF staff.

Issue 5: Maintain Community Quality of Life and Economic Resiliency

1. Issue Description

This issue recognizes the significant and varied contributions our forests play in respect to the quality of life in our communities as well as the resiliency of local and regional economies. The blending of both issues indicates the need for our forests to serve multiple ends. This includes their availability for a wide range of recreational pursuits and high quality ecological services (clean air and water, and biodiversity), while at the same time sustaining local economies through a diversity of products. It also relates to balancing economic development opportunities (such as emerging bioenergy markets) with minimizing threats and impacts to the substantial recreational, environmental and aesthetic values associated with our natural resources in public forests and communities.

- ***Forest Resource*** - Michigan boasts a variety of rural and urban forest resources that contribute to both community quality of life and economic health, and contribute unique products to multiple industries. These healthy, abundant forest resources in Michigan are important sources of timber, wildlife habitat, and multiple outdoor recreation and tourism activities. They also serve as the basis for a variety of ecological services such as clean air and water which are increasingly of concern in other localities, but which Michigan has in abundance.

- ***Public Benefit*** - Historically, Michigan's trees and forests have been a source of economic wealth and development as well as aesthetic beauty. The state's forests have significantly recovered from over-exploitation in the late 1800s to early 1900s, although soils, forest systems and some forest types remain impaired. Likewise, Michigan communities have recovered from the devastation of Dutch Elm Disease, but are now challenged by new threats such as the Emerald Ash Borer. Forest-based industry remains an important economic sector, especially in more rural northern areas. Beyond the importance of an active forest products industry, the state's latest tourism campaign, Pure Michigan®, touts vibrant and beautiful communities and forests as part of "unspoiled nature" that provide visitors a compelling reason to visit. Forests also play a central role in residents' quality of life across the rural-urban spectrum, based on values associated with aesthetics, spirituality, recreation, timber, and non-timber products.

Community residents often refer to their local forest resource as an important contributor to their sense of place.

- ***Key Attributes*** - Several ecological and structural conditions significantly influence these public benefits. Strong economic forest industries rely on a healthy and vigorous growing stock that is readily accessible. Forest owners must be willing to actively manage their lands sustainably and make their timber available for appropriate markets. Contiguous forest lands are central to forest products industries, tourism amenities and ecological benefits. A diversity of forest cover types and settings is also critical to accommodate multiple tourism and recreation ventures.

  In the context of the urban forest, community trees yield great economic (property value), environmental (air and water quality), and social (reduced crime) benefits.

- ***Direct Threats*** - The introduction of invasive pests and diseases continue to threaten both urban and rural forests, including future regeneration. The past decade's economic conditions have led to reduced community budgets and management of urban trees, declines and losses of mills in the state, and reduced markets for timber resources. On the supply side, attitudes toward timber harvest among some private landowners have resulted in a reluctance to manage for timber. Decreases in forest parcel size have also made harvesting operations relatively impractical in many local regions. The tourism industry in general is particularly vulnerable to economic downturns, which in turn subjects communities with abundant natural resource amenities to unsustainable boom-bust cycles. Success in tourism and associated recreation development (including second home development) can itself result in declines in local residents' quality of life if development growth is unplanned and uncontrolled.

- ***Contributing Factors*** - Invasive plants, insects, and diseases are a result of multiple introductions based on globalized trade and other commercial transport, and climate changes. Public ignorance of disease/insect vectors and their corresponding damage potential further distribute prolific invaders thorough activities such as firewood transport and seed dispersal on recreational vehicles. Local public policies and tax structures often encourage overwhelming development pressures and property tax burdens that encourage forest land parcelization and conversion to alternate uses, such as housing or commercial developments. These changes are touted as boosting local economic health, but often lead to reduced overall ecological health and community quality of life. Reduced forest parcel size can be an obstacle to economically viable forest product development unless neighbors coordinate their harvest activity. However, forest landowners are often reluctant to work together in this way.

- ***Opportunities*** - Recent concerns about energy use and environmental conditions have encouraged a growing interest in "green" infrastructure in local communities and the value of ecosystem services. Residents, particularly in the northern portions of the state, continue to be supportive of local forest products industries. New potential markets related to woody biomass and carbon sequestration may also contribute to a more robust industry in the future. The following opportunities specifically relate to this issue's key attributes:
  - Biomass Utilization & Restoration Network for the Upper Peninsula (BURN-UP): A program sponsored by the UP RC&D is designed to promote the sustainable use of woody biomass for energy systems.
  - Biomass Research: Michigan State (MSU) and Michigan Tech Universities (MTU) work in tandem to research cellulosic fuel manufacturing for economically viable liquid fuel systems.
  - Forest Biomass Innovation Center: An MSU Agricultural Experiment Station site located in the Escanaba area, focusing on forest and plantation research and outreach on woody biomass source materials.

- Land Conservancies: According to Heart of the Lakes Center for Land Conservation Policy, there are at least 23 land conservancies currently operating in the state, with a total of over 500,000 acres enrolled in some form of protection from development.
- Michigan Natural Resources Trust Fund (MNRTF): This fund provides financial support to local communities to purchase areas that are considered ecologically significant and/or recreationally promising. Since 1976, over $800 million has been spent to fund more than 1,200 state and local recreation projects.
- MSU Land Policy Institute: The Land Policy Institute offers research and outreach activities for local communities and decision makers on land use issues, including proper planning and zoning activities that protect working lands and other green spaces (including forests).
- Other opportunities parallel those related to Theme 1, Issue 2: Divestiture, parcelization, and conversion of private forest lands.

- ***Geographic Attributes*** - Priority areas for maintaining community quality of life and economic resiliency are shown in Figure 3.13. Reflecting the two-pronged issue (quality of life and economic resiliency), these priorities are influenced by a blending of areas of focus for outdoor recreation and nature appreciation with areas where the forest products industry is a greater part of the economy. Public lands and proximity to public lands received the highest weighting for this issue, closely followed by three layers relating to timber markets and wood products. However, there were also five other quality of life layers also given weight: recreational trails, nature reserves, cultural and historic areas, huntable lands, and campgrounds, and boating and fishing access sites. The summed results gave much of the U.P. a high weight along with interior areas within the northern lower peninsula.

2. Strategies

The following strategies are identified to address this issue:

- Work with local decision makers and community leaders to articulate forest-based values and benefits that can be used as a basis for local planning and zoning efforts.
- Partner with MSU Land Policy Institute (LPI) to explicitly incorporate forest and forestry interests in their green space research and instruction.
- Provide information to local decision makers and community leaders on the multiple economic benefits of forested lands, including new markets.
- Encourage private landowners' use of tools such as conservation easements to preserve working forest lands and control development pressure.
- Encourage communities' planning efforts to take advantage of land acquisition for sites with special forest characteristics that enhance the area's character and ecological health.
- Build awareness of the important contributions that trees provide to urban areas and communities, and highlight their quantitative value and impacts.

3. Required Resources

The following DNRE resources are currently being used to address the above strategies:

- Forest Management Division, Forest Stewardship and Urban and Community Forestry program staff

The following partners are needed to address the above strategies:

- Michigan Department of Labor and Economic Growth
- Michigan Economic Development Corporation
- Michigan Forest Stewardship Advisory Committee
- Michigan Urban and Community Forestry Council
- MSU Extension
- MSU Land Policy Institute
- The Nature Conservancy
- Other Land Conservancies

4. The following performance measures will be used to assess progress in attaining strategies:
   - Number of landowners (and acreages) enrolled in conservation easements.
   - Number of applications to funding sources such as MNRTF.
   - Number of communities applying for protection funding for the first time.
   - Number of workshops offered by MSU LPI containing forest-based components.
   - Proportion of communities incorporating forested lands in planning and zoning activities.
   - Increase in woody biomass availability at the regional or local level.

Issue 6: Maintain and Enhance Scenic and Cultural Quality on Private Forestland

1. Issue Description

   The scenic and cultural quality is both an innate tangible and intangible characteristic that people commonly associate with forests. Several legislated programs contribute to the maintenance of scenic and cultural values, including designated critical dunes, natural and wilderness areas, and wild and scenic rivers, natural rivers, natural beauty roads, farmland and open space preservation, and commercial forest.

   - ***Forest Resource*** - Forestland is a component of many scenic and cultural features in Michigan, including national and state parks and forests, 3,299 miles of Great Lakes shoreline, 75,000 acres of sand dunes, 11,000 inland lakes, 36,000 miles of rivers and streams, trails, scenic vistas, and color tours. Cultural areas include forestlands that have traditionally been used by Native American's and others for spiritual purposes, for gathering, and other activities. Many areas are specifically noted for their scenic values, and are promoted as such (e.g. MDOT designated Great Lakes Circle Tour, and Scenic and Historical routes).

   - ***Public Benefit*** - Scenic forests contribute many social and economic benefits to the public, including recreation and tourism (a multi-billion dollar industry in Michigan), and intrinsic values (appreciation of natural landscapes, spirituality, etc.). Forestland that is enrolled as farmland and open space contribute to a vibrant agricultural economy. Forestland that is enrolled in the Commercial Forest Program also contributes to a vibrant forest products industry.

   - ***Key Attributes*** - A "natural appearing" landscape with no or little presence of development is generally a key condition for perceived scenic forests. Unobtrusive or developed structures that are perceived as quaint or consistent with the scenic value are often part of these landscapes.

   - ***Direct Threats*** - Land-use activities or development of structures that are inconsistent with the scenic value are a threat to key values and the public benefit.

   - ***Contributing Factors*** - Factors that contribute to the direct threats are trends in rural and ex-urban development (land division and land development into other uses).

   - ***Opportunities*** - Opportunities reducing the cost of owning forestland include conservation easements for working forest land, and other incentives such as the Commercial Forest and Qualified Forest Programs.

   - ***Geographic Attributes*** - Priority areas for maintaining and enhancing scenic and cultural quality on private Michigan forestland are shown in Figure 3.14. These areas emphasize identified scenic areas, public lands (including national and State Parks), and cultural and historical areas.

2. Strategies

The following strategies are identified to address this issue:

- Seek to purchase conservation easements on forestland of scenic and/or cultural value.
- Provide information and technical guidance to private forestland owners regarding the Commercial Forest and Qualified Forest Program options for sustainably managing their lands for scenic and cultural values.

3. Required Resources

The following DNRE resources are currently being used to address the above strategies:

- Forest Management Division, Forest Stewardship, Forest Legacy, and Commercial Forest Program staff

The following partners are needed to address the above strategies:

- Forest Legacy Subcommittee of the Forest Stewardship Program State Advisory Committee
- Michigan Department of Transportation
- The Nature Conservancy
- Other Land Conservancies

4. Performance Measures

- Number of conservation easements purchased.
- Number of new ownership enrolled in as Commercial Forest.
- Number of new ownership enrolled as Qualified Forest.

Issue 7: Maintain Forested Ecosystems for Biodiversity and Wildlife Habitat

1. Issue Description

Biodiversity includes abiotic components (such as soil) and floral and faunal biotic components (such as trees, shrubs, and herbaceous plants that provide habitat for associated animal species). Biodiversity is important at multiple scales, at the ecosystem, species, and genetic levels.

This is a multi-state issue that is being addressed through Threatened and Endangered Species habitat restoration programs in cooperation with the States of Indiana and Wisconsin.

- ***Forest Resource*** - Private lands account for 80 percent Michigan's land ownership and 61 percent of the forest land. Many species of wildlife depend upon forests and woodlands to provide a portion or all of their essential needs. Wildlife species thus depend disproportionately upon private lands for their well being. Forests are a significant component of the overall native biological diversity (biodiversity) of Michigan.

- ***Public Benefit*** - There are numerous public benefits that biodiversity provides to the public, including provision of habitat for a wide spectrum of plant and animal species, and the provision of genetic refugia that help to preclude the catastrophic loss of any individual species.

  Michigan citizens are interested in the wildlife that their forest land can produce and maintain.

- ***Key Attributes*** - Three key criteria are critical for producing public benefits from the conservation of biodiversity. These are functionality, quality and condition, and social/economic criterion. Functionality criteria include the landscape context, size and connectivity of natural communities. Quality and condition criteria are a measure of the composition, structure and natural processes of natural communities. Social and economic criteria include management costs and opportunity costs and benefits of natural communities.

Four key forest attributes are sought to benefit some wildlife species:

- The provision of hard mast (particularly from oak and hickory trees), which are high in fats, carbohydrates, and good sources of proteins that are available over long periods of year. These are used disproportionately by waterfowl, upland game birds, deer, bear. and squirrels.
- Short rotation young forests (particularly aspen) provides summer and winter forage for deer, elk, and grouse that is not accessible in mature forests. They also provide essential breeding habitat for grouse and wood cock.
- Structurally diverse forests with uneven age-class distributions (particularly northern hardwoods), which provide food, cover and other habitat needs for forest song birds, reptiles, amphibians, and small mammals, many of which are species at risk.
- The presence of mesic/lowland conifers (particularly white pine and hemlock) provides food, breeding habitat, and winter cover for song birds, deer, bobcat, red squirrel, and salamanders. Lowland white cedar provides winter food and thermal cover for deer.

- ***Direct Threats*** - Threats to the conservation of biodiversity include development and conversion to other uses, fragmentation of natural communities, invasive species, and degradation of communities by poor forest management practices and other uses.

  Specific threats to wildlife species stem from the history and future management of forest resources. Examples include declining oak and aspen components of Michigan's forests. For oak this is due to poor regeneration, which may be a result of deer herbivory, or the fact that current conditions are different from those that existed when the oak was established (a historical period of lumbering and extensive and severe wildlfires). Much of the aspen component, particularly on private lands, is senescing and will be lost if not cut. The mesic conifer component is frequently poorly represented on sites that it once occupied. Cedar often does not regenerate well, particularly at sites where deer over-winter.

- ***Contributing Factors*** - Strong economic disincentives for the conservation of biodiversity and unawareness of biodiversity values contribute to making direct threats strong and difficult to manage.

- ***Opportunities*** - Opportunities for directly improving key attributes include: conservation easements, incorporating biodiversity information, and management options into Forest Stewardship Plans and cooperative planning efforts with private forest resources.

  Opportunities for improving attributes for wildlife habitat include promoting the retention and regeneration of oak and hickory, aspen, and mesic, and lowland conifers, and by diversifying the age, composition, and structure of northern hardwood forests.

- ***Geographic Attributes*** - Priority areas for the conservation of biodiversity and some rare wildlife species in Michigan are shown in Figure 3.15. Spatial analysis for this issue was limited by a lack of consistent and systematic statewide data layers. For example, the most important data layer represented known locations of threatened and endangered species, rare natural community types, and ecological reference areas (natural communities that are both rare and of high quality). Not all occurrences of these species or natural communities are known, as there is not a systematic, statewide data layer. The application of high priority areas for the conservation of biodiversity must recognize this limitation.

  The Michigan DNRE is in the process of implementing a systematic process to conserve biodiversity on a state-wide scale, which will result in designated Biodiversity Stewardship Areas located upon all ownerships in the state. When completed, these areas will be integrated into a future revision of the Michigan Forest Resource Assessment and Strategy, and will provide the basis for a more comprehensive analysis for high priority areas.

Although the 2008 farm bill requires the Forest Resource Assessment and Strategy to incorporate Michigan's Wildlife Action Plan (WAP), this was not possible at the present time as the Michigan WAP is presently being updated to include a spatial component for priority wildlife species. Incorporation of spatially explicit areas to address priority species from the Michigan WAP will be integrated into a future revision of the Michigan Forest Resource Assessment and Strategy.

2. Strategies
The following strategies are identified to address this issue:
   - Outreach to partners in areas where there are identified biodiversity values.
   - Target Forest Legacy conservation easements or fee acquisition in areas where there are identified high biodiversity values on private forestlands.
   - Use landowner assistance programs, such as the Landowner Incentive Program (LIP), the Forest Stewardship Program (FSP), the USDA Natural Resource Conservation Service, Environmental Quality Incentive Program (EQIP) and the Wildlife Habitat Incentive Program (WHIP) to assist landowners in managing private forestland for habitat for wildlife species identified by Michigan's Wildlife Action Plan, Federal and State endangered species lists, and the state featured species list.

3. Required Resources
The following DNRE resources are currently being used to address the above strategies:
   - Forest Management Division, Forest Stewardship and Forest Legacy Program staff
   - Wildlife Division, Private Lands Program staff
   - Wildlife Division, Wildlife Action Plan coordinator
   - Wildlife Division, Threatened and Endangered Species coordinator

   The following partners are needed to address the above strategies:
   - U.S. Department of the Interior, Fish and Wildlife Service
   - USDA Natural Resource Conservation Service
   - Forest Legacy Subcommittee of the Forest Stewardship Program State Advisory Committee
   - The Nature Conservancy
   - Other Land Conservancies

4. Performance Measures
The following performance measures will be used to assess progress in attaining strategies:
   - The number of conservation easements on private forestlands with significant biodiversity value.
   - The number of management plans and acreage written under the LIP, WHIP, and EQIP programs.

Issue 8: Maintain and Enhance Access to Recreational Activities on Private Forestlands

1. Issue Description
Private forest lands provide habitat for a wide variety of terrestrial and aquatic game and non-game wildlife species that enable some dispersed hunting, fishing, and trapping opportunities. Private lands also provide an opportunity to expand and secure a system of long distance public land and water trails in Michigan.

   This is a multi-state issue that is being addressed through several initiatives in cooperation with the States of Illinois, Indiana, and Wisconsin, including:
   - Great Lakes Circle Tours; and
   - Multi-state recreation infrastructure, such as the North Country Trail.

- ***Forest Resource*** - Sixty-one percent of Michigan's forests are under private ownership. Most private nonindustrial forestland is located in the Lower Peninsula, while most private industrial forestland is located in the Upper Peninsula. Over half of private landowners own fewer than 10 acres, and collectively control only 7 percent of private forestland (USDA 2004).

- ***Public Benefit*** - Private forest lands can provide critical linkages necessary to achieve long distance trail connectivity of regional and statewide significance to promote recreational, economic, and health benefits. Some private forest lands also provide access opportunities for dispersed hunting, fishing, and trapping activities.

- ***Key Attributes*** - Access to recreation on private forestlands is very often dependent upon the willingness of the owner to grant such a right. These rights are necessary for the establishment of a well developed and maintained interconnected system of public land and water trails, which can support a viable and sustainable statewide trail system and tourism industry.

  The ability of private forestland to provide habitat is also a key condition. Private forests play a large role in providing a wide spectrum of plant and wildlife habitat conditions. Habitat needs are highly variable and dependent upon the life history characteristics of each species. For wildlife species that depend upon forests from all or a portion of their habitat, the key attribute is the permanence of the forest itself. A secondary attribute is the condition of the forest, in terms of successional state, and vegetative composition and structural characteristics.

- ***Direct Threats*** - Threats to dispersed recreational activities and establishing public trails on private forest lands include landowners who are unwilling to provide public access, divestiture, and parcelization of private forestland to other ownerships, and localized commercial and residential development or conversion to other uses that exclude access.

- ***Contributing Factors*** - Trends in rural and ex-urban development (urban sprawl) contribute to making direct threats difficult to manage. Newer generational owners may not have the same attachment or long-term commitment to the forest resource as the current ownership. In addition, private forestlands enrolled as Commercial Forest also contribute to making direct threats more difficult to manage because developed recreation and commercial use can not occur on those lands.

- ***Opportunities*** - Opportunities for the establishment of permanent public trails on private forestlands include cultivating willing private forestland owners, securing permanent recreation use easements, long-term leases, land acquisition, or other instruments to secure long-term rights in private forestland for public trail use.

  Opportunities for establishing public access to private forestland or lakes and rivers for the purpose of dispersed recreation include:

  - Fee acquisition of lands;
  - Financial incentives to private landowners to obtain access; and
  - Marketing and provision of information to enable recreational use.

- ***Geographic Attributes*** - Priority areas to maintain, and enhance public recreational trail activities on private forestland are shown in Figure 3.16. These priority areas focus upon proximity to public lands, and existing recreational trails, campgrounds, boating and fishing access sites, roads, and huntable lands.

2. Strategies

The following strategies are identified to address this issue:

- Actively solicit and foster support and understanding from private forestland owners of the significance and benefits of public trail development and designation.
- Target acquisition of permanent rights in private forestlands for public trail use at priority locations in the Upper Peninsula and Northern Lower Peninsula to achieve critical linkages in regional and statewide trail networks.
- Pursue trail acquisitions consistent with trail initiatives outlined in Michigan's 2008-2012 Statewide Comprehensive Outdoor Recreation Plan (SCORP), and Off-Road Vehicle (ORV) Management Plan 2008. Both plans are available on the DNRE Website; the full 2008-2012 SCORP is available at http://www.michigan.gov/dnr/0,1607,7-153-10366_37984-176508--,00.html, and the full ORV Management Plan 2008 is available at: http://www.michigan.gov/documents/dnr/ORVPlanApproved234099_7.pdf
- Obtain land and water access rights for hunting, boating and fishing through fee acquisition, land trades, or gifts.
- Provide financial incentives to private landowners to obtain access rights, including:
  - Contract payments through the DNRE Hunting Access Program (in southern Michigan);
  - Tax incentives through the Commercial Forest Program;
  - Purchase of conservation easements;
  - Future incentivized access to farms to enable deer hunting in areas of excessive deer numbers and chronic crop damage reports.
- Provide information to enable recreation on private lands. Means include:
  - Printed guides to Commercial Forest and Hunter Access Program lands;
  - Web-based map applications that show the location of lands open to hunting and fishing access; and
  - Web-based MI-Hunt, which allows users to view:
    - All state game and wildlife areas;
    - Huntable lands by vegetation types;
    - The topography and foliage cover of huntable lands;
    - Recreational facilities such as forest campgrounds, trails;
    - Wildlife areas and boat launches; and
    - Street maps and directions to huntable areas
- Use multi-media marketing to promote outdoor recreational opportunities.

3. Required Resources

The following DNRE resources are currently being used to address the above strategies:

- Forest Management Division, Recreation and Trails Section program staff
- Forest Management Division, Forest Stewardship and Forest Legacy program staff
- Forest Management Division, Commercial Forest program staff
- Wildlife Division, Private Lands Program staff

The following partners are needed to address the above strategies:

- Michigan Snowmobile and Trails Advisory Council
- Forest Management Advisory Committee
- Citizens Committee for Michigan State Parks
- The Michigan Trails and Greenways Alliance
- Michigan Snowmobile Association
- Cycle Conservation Club of Michigan
- Michigan Recreation and Parks Association
- Michigan Mountain Bike Association
- Michigan Horse Council

4. Performance Measures

The following performance measures will be used to assess progress in attaining strategies:

- Number of private forestland easements, leases or other instruments securing permanent or long-term rights for public access or trail use.
- Number of miles of permanent public trails acquired on private forestlands.
- Ownerships or acreage enrolled as commercial forest land and in the Hunter Access Program.
- Number of new boat and fishing access sites.
- Number of printed guides distributed.
- Number of hits for web-based applications.
- Fiscal resources spent on marketing campaigns.

Issue 9: Reforestation of Urban and Ex-Urban Areas

1. Issue Description

Surveys indicate that urban forests across the country are continuing to lose tree cover each year. In the past 25 years alone, more than 600 million trees have been removed in urban areas for a variety of reasons. Michigan is no different and may be worse off due to the recent impacts of the Emerald Ash Borer (EAB), which has resulted in the death of more than 30 million trees since 2002. There is also a loss of trees in areas surrounding urban communities due to development and urban sprawl. Consequently, there is an enormous need to replace trees in urban and ex-urban areas where loses have occurred or threats are the greatest.

- ***Forest Resource*** - As of 2000, urban or community land in Michigan comprised 7.3 percent of the land area and had an estimated 107.8 million trees, of which an estimated 1.5 million are urban street trees. Average tree canopy cover in urban or community areas of Michigan is about 21 percent, with over 24 percent impervious surface cover and almost 28 percent of the total green space covered by tree canopy cover (Nowak and Greenfield 2010).

  Over 80 percent of Michigan's population lives in urban/ex-urban areas (Nowak and Greenfield 2010). Urban sprawl, second homes and land conversion threaten forest resource as ownerships becomes smaller, more fragmented, subject to various local ordinances, and subject to increasingly disparate forest resource values among different ownerships. These issues create significant resource management challenges for private landowners and resource management agencies.

  As a consequence of development, the character and function of these lands is also changing. Specifically, the ecological and material benefits that private forest lands provide are greatly reduced or lost entirely. Therefore, it is critically important to identify at risk landscapes, current and future threats, their causes, and promote programs that support awareness of the need to maintain private urban and ex-urban forests.

- ***Public Benefit*** - Urban and community forests (UCF) are important for human and ecological health (Nowak and Dwyer 2007). The benefits attributed to urban and community trees are well documented. Michigan's urban and community forests are estimated to store about 20.6 million metric tons of carbon (valued at $469.7 million), and annually remove about 678,000 metric tons of carbon (valued at $15.5 million) and 14,820 metric tons of air pollution (valued at $121.7 million) (Nowak and Greenfield 2010). Additionally, trees in urban environments provide numerous other benefits including wildlife habitat, improved property values, and storm water management (Morales et al. 1976).

  To ensure the maximum public benefits are achieved from these resources, local units of government, (cities, villages, and townships etc.) are entrusted with management at the local level. The level of management provided is highly variable, ranging from non-existent to highly proactive. This depends greatly on the social, economic, ecologic, and political attributes of the community.

- ***Key Attributes*** - Maintaining and expanding healthy tree cover in urban and ex-urban areas is a key attribute that is necessary to maximize the myriad benefits provided by trees and forests.

- ***Direct Threats*** - Direct threats to urban and ex-urban forests include:
  - Loss of trees due to insect/disease threats;
  - Loss of trees due to storm damage;
  - Loss of trees due to development; and
  - Lack of local tree care program/staff.

- ***Contributing Factors*** - Contributing factors that reinforce these threats include:
  - Lack of species diversity;
  - Introduction of nonnative, exotic plants and animals/insects;
  - Urban sprawl;
  - Lack of local tree protection policies; and
  - Lack of education and awareness about the role of trees and forests and the benefits they provide.

- ***Opportunities*** - Opportunities to improve reforestation of urban and ex-urban areas include:
  - Providing outreach and education on the need for/benefits of planting and maintaining trees in urban and ex-urban areas;
  - Providing technical assistance in proper selection, planting and care of trees;
  - Guiding communities in the use of tools and resources for assessing and managing tree cover (e.g. urban tree canopy analysis, i-TREE etc.); and
  - Facilitating networks between new and existing partners for tree planting.

- ***Geographic Attributes*** - Priority areas for reforestation of urban and ex-urban areas are shown in Figure 3.17. There are three main target areas for addressing reforestation: urban areas, ex-urban areas, and communities that are participating in the Tree City USA program.

  Urban areas are specifically those communities determined from the Maryland Method of spatial analysis that were further combined with areas of known insect/disease damage (specifically from Emerald Ash Borer, and Oak Wilt). Urban areas have suffered the greatest impacts due to insect/disease and storms, not to mention that health and environmental issues are greatest in urban areas, where more than 80 percent of Michigan's population lives.

  Ex-urban areas (i.e. the wild land urban interface (WUI)) are determined by the WUI dataset spatial analysis combined with development threat datasets. Ex-urban areas face ongoing threats of tree cover loss from development and urban sprawl. Areas where these two geographies (urban and exurban) overlap would are the highest priority for reforestation.

  The Arbor Day Foundation's (ADF) Tree City USA program is an annual recognition program that requires communities to report the total number of trees planted, removed and pruned. Of Michigan's 119 certified Tree City USAs in 2009, nearly half self-reported that they removed more trees than they planted. These communities should be targeted for further tree planting assistance though various grant opportunities.

2. Strategies

   The following strategies are identified to address this issue:
   - Improve the state UCF program's capacity to spatially assess, analyze and prioritize areas of need using various tools (e.g. GIS, remote sensing, etc.).
   - Create appropriate outreach and education messages for urban and community audiences related to preserving private forestlands.
   - Target distribution of tree planting grant assistance to priority areas in the following order:

- Where urban and ex-urban areas overlap;
- Urban areas;
- Ex-urban areas; and
- Tree City USA communities where tree removals exceeded trees planted.

3. Required Resources

The following DNRE resources are currently being used to address the above strategies:

- Forest Management Division, Urban and Community Forestry Program staff
- Forest Management Division, Resource Assessment Unit staff

The following partners are needed to address the above strategies:

- USDA Forest Service, state and private forestry programs and research stations
- National Association of State Foresters and Northeastern Area Association of State Foresters
- National Urban and Community Forestry Advisory Council
- Michigan Urban and Community Forestry Council
- DTE Energy and DTE Energy Foundation
- The Greening of Detroit
- Global ReLeaf of Michigan
- Michigan State University Extension
- Arbor Day Foundation
- Arboriculture Society of Michigan
- County Conservation Districts
- Michigan Arbor Day Alliance
- Local units of government
- Various local nonprofit organizations

4. Performance Measures

The following performance measures will be used to assess progress in attaining strategies:

- Percent change in canopy cover (community level info based on availability of current, local inventory/assessment).
- Percent change in species diversity (community level info based on availability of current, local inventory/assessment).
- Number of trees planted in priority areas.
- Number of tree planting grants awarded in all priority areas.
- Total funds expended from UCF program grants in all priority areas.
- Number of volunteer hours contributed to tree planting in all priority areas.
- Number of Tree City USA communities planting more trees than removing.
- Number of trees planted vs. removed in Tree City USA communities.

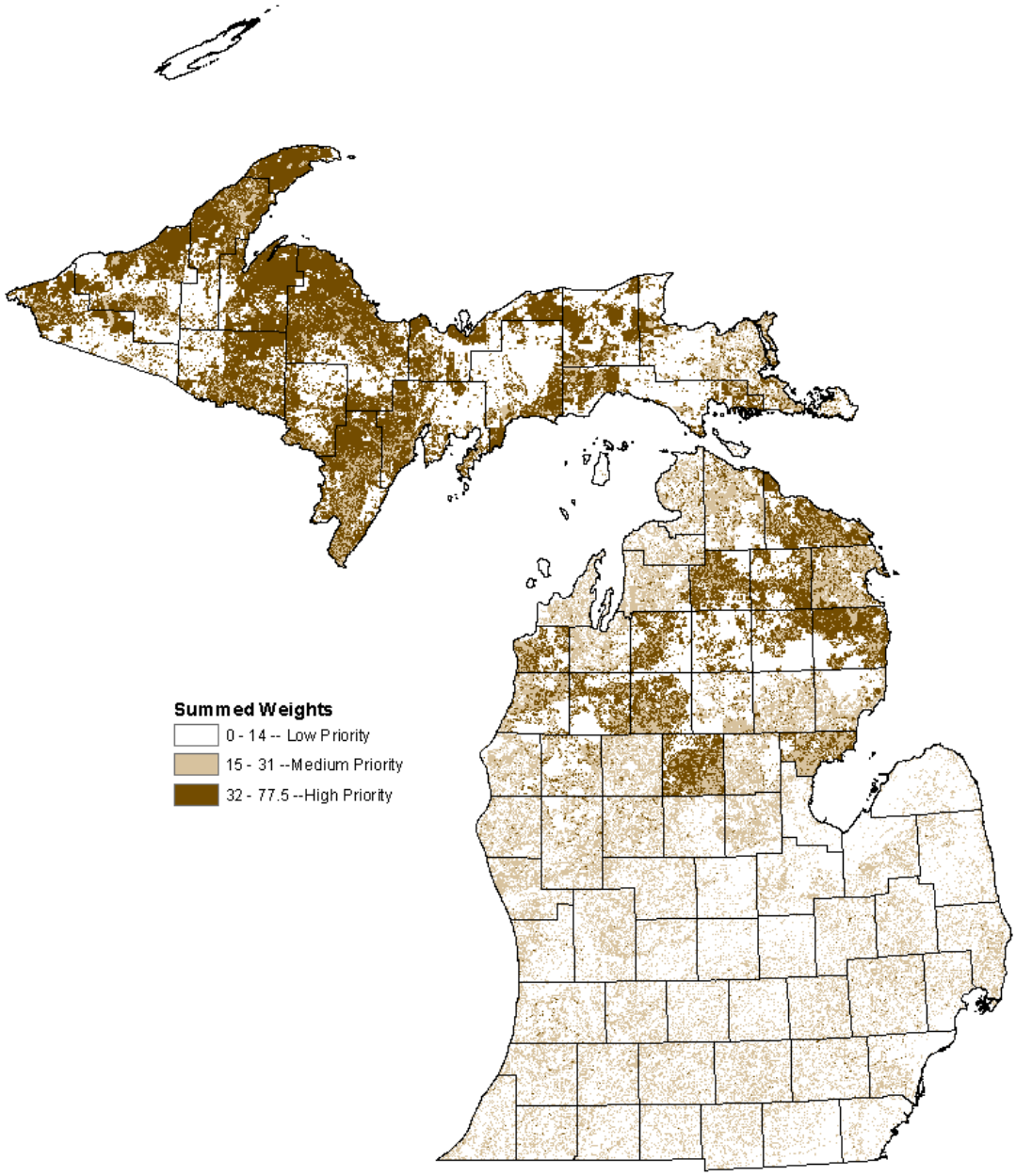


Figure 3.1. Priority areas for promoting sustainable active management of private forestland in Michigan (DNRE data).

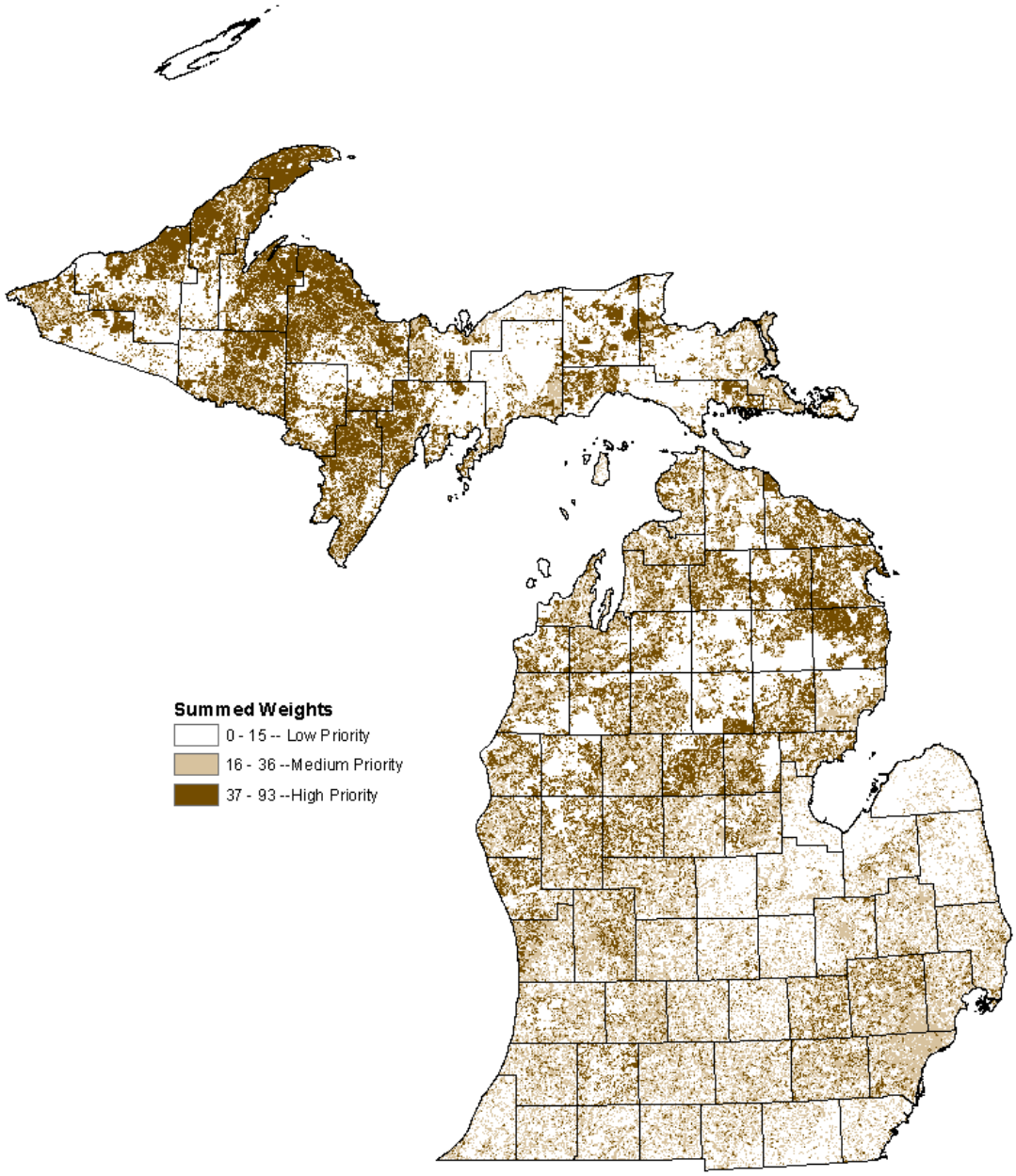


Figure 3.2. Priority areas for reducing divestiture, parcelization and conversion of private forestland in Michigan (DNRE data).

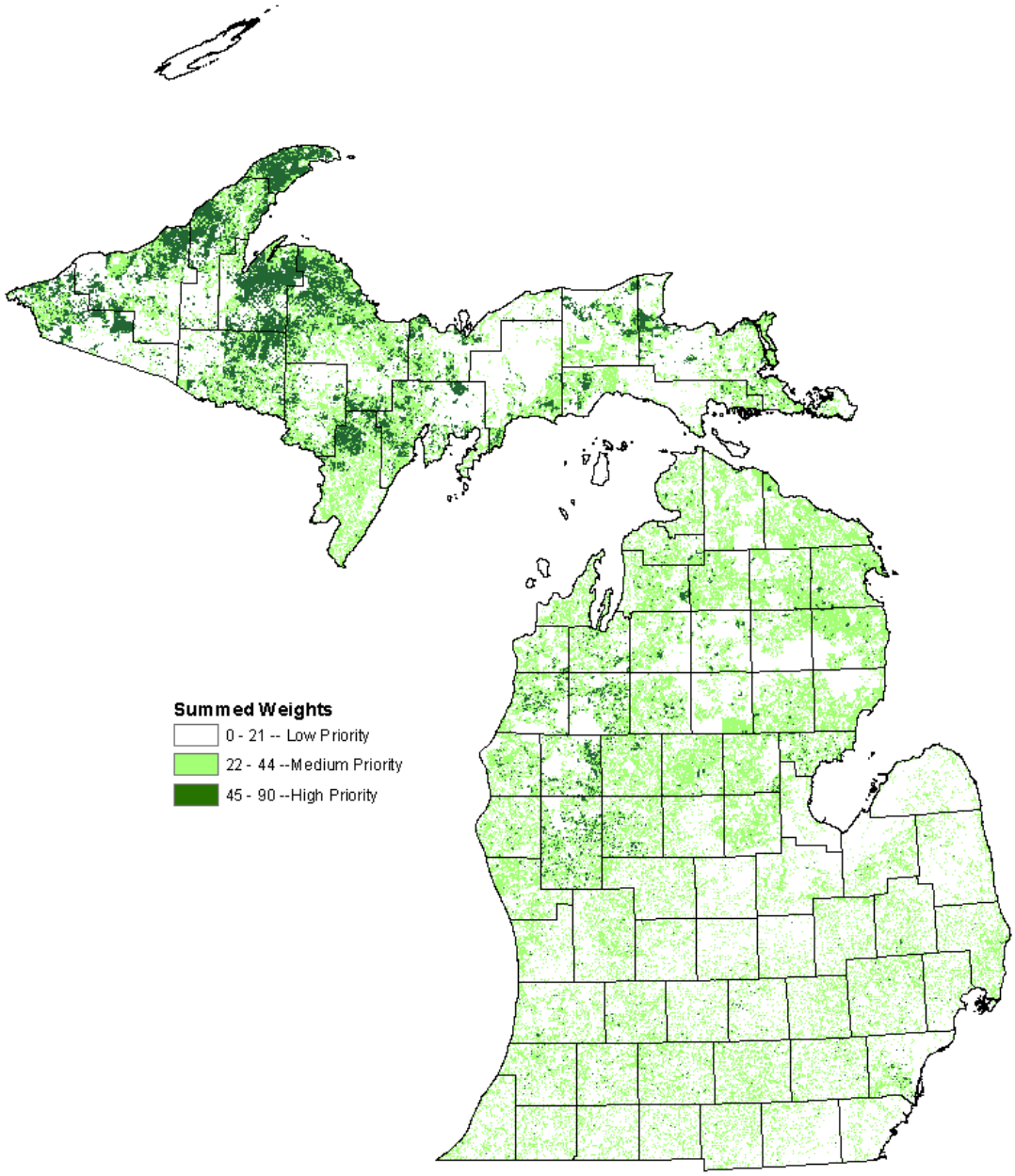


Figure 3.3. Priority areas for providing incentives to private landowners to maintain forestland in Michigan (DNRE data).

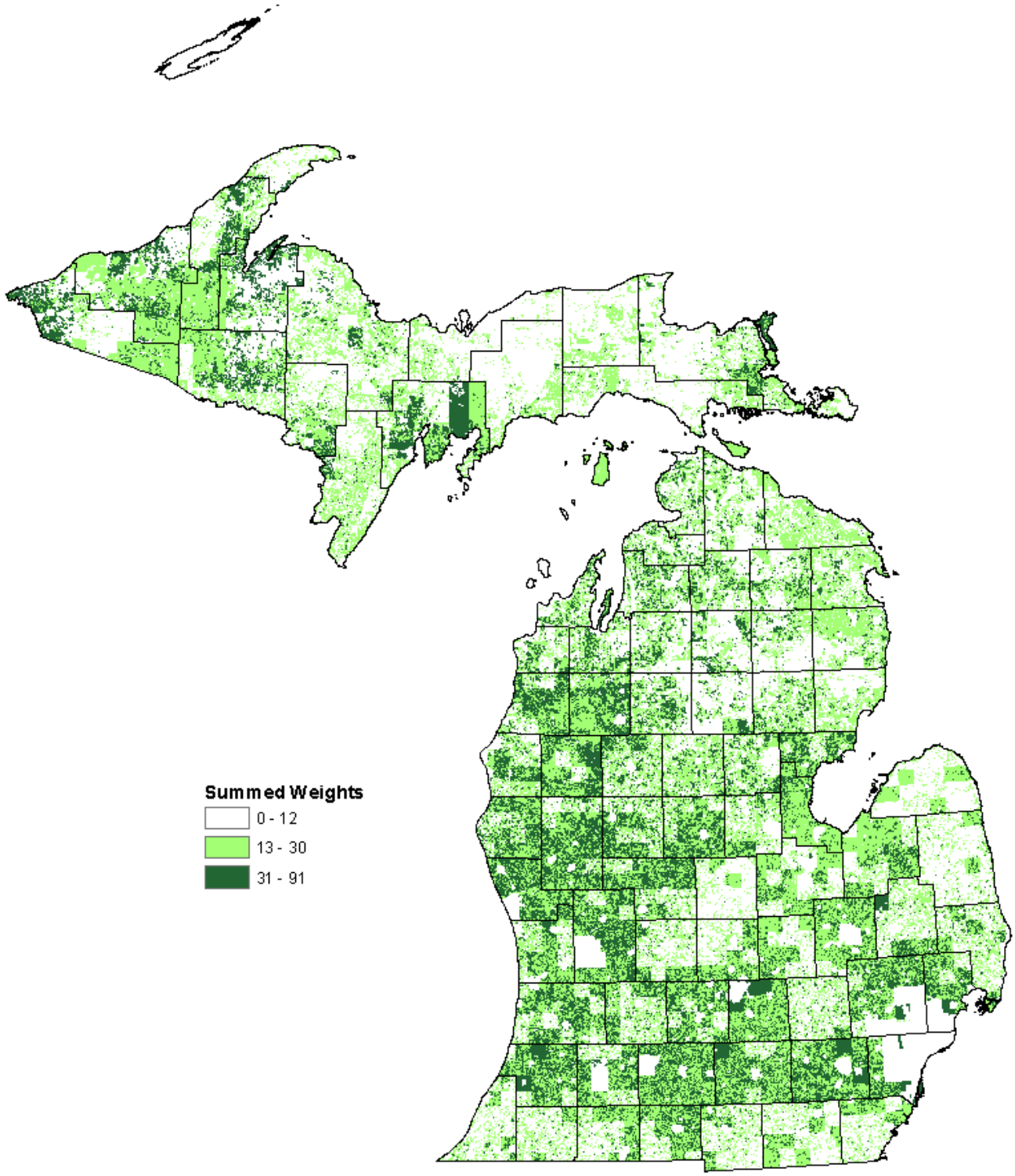


Figure 3.4. Priority areas for reducing the high cost of owning private forestland in Michigan (DNRE data).

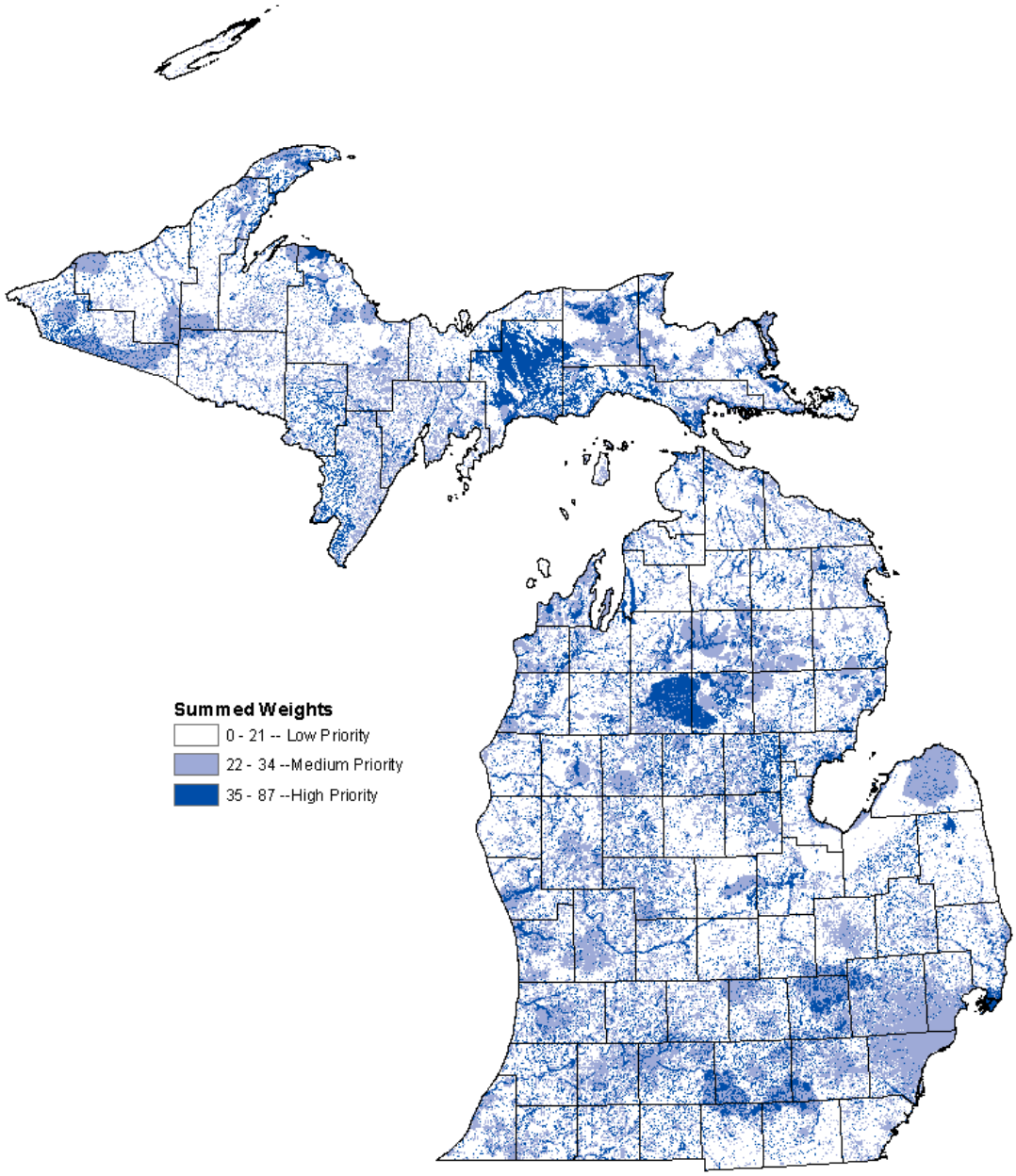


Figure 3.5. Priority areas for the maintaining and restoring aquatic ecosystems and watersheds in Michigan (DNRE data).

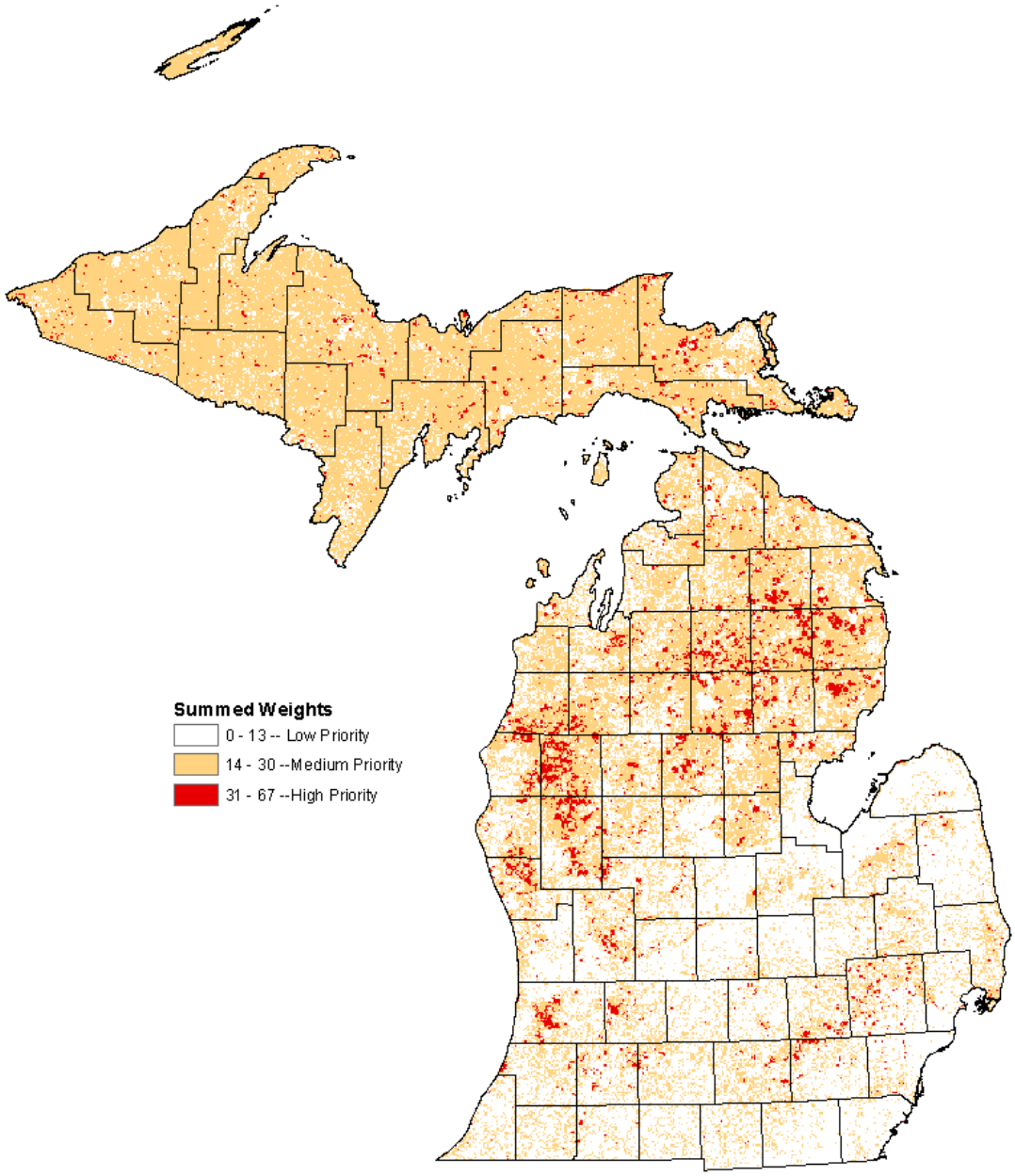


Figure 3.6. Priority areas for reducing threats from invasive species, pests and disease in Michigan (DNRE data).

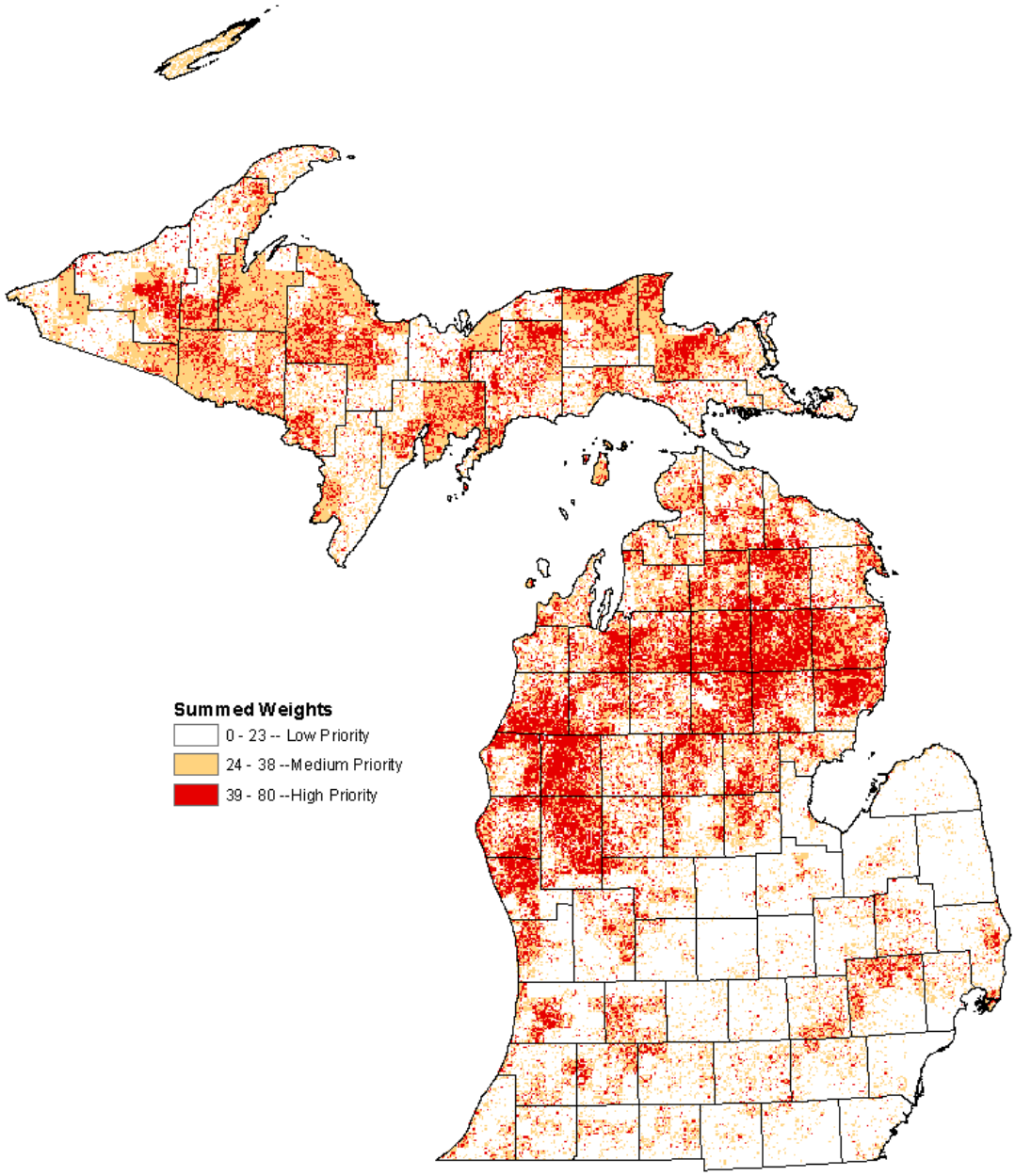


Figure 3.7. Priority areas for reducing wildfire risk and improving public safety in Michigan (DNRE data).

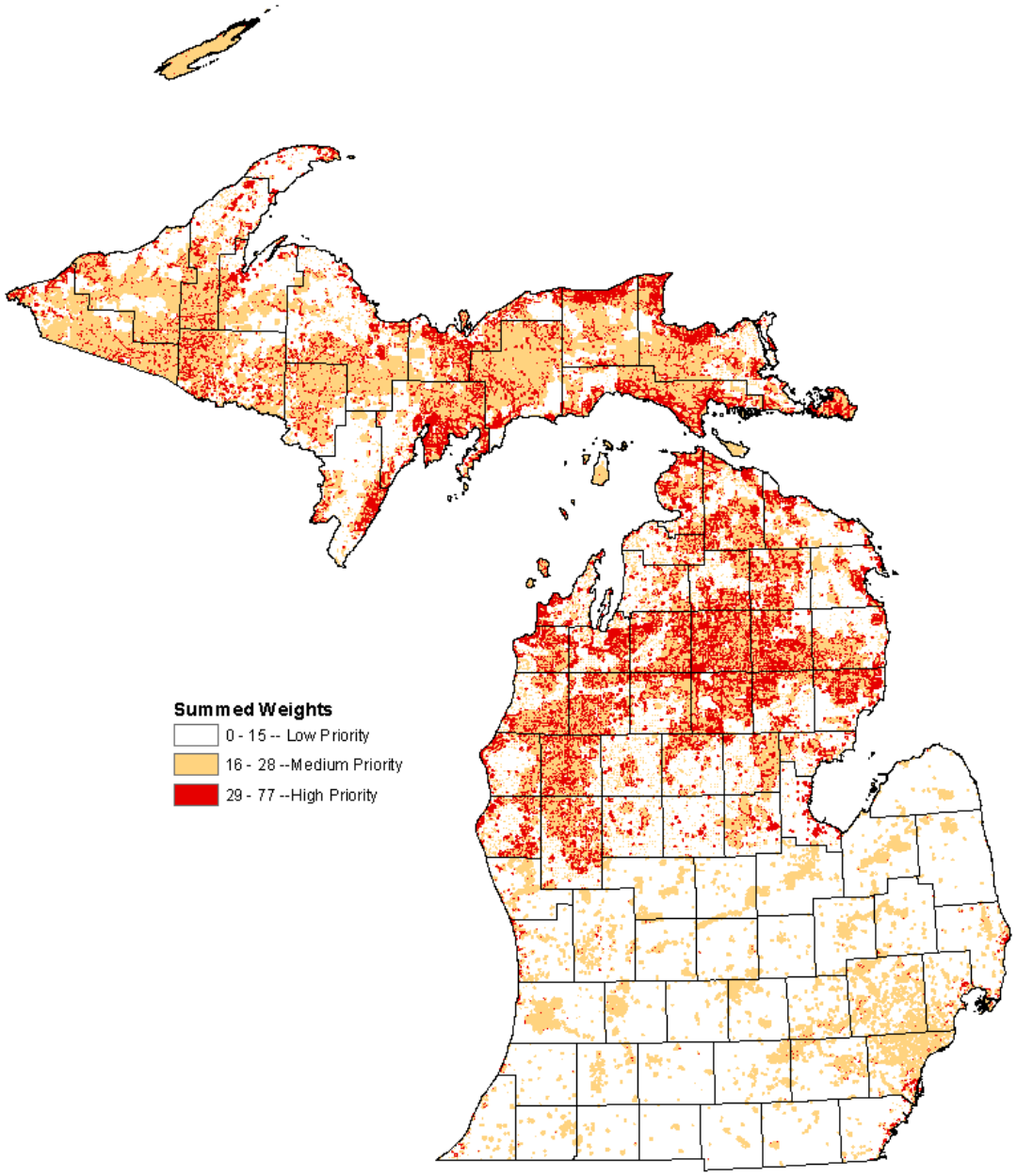


Figure 3.8. Priority areas for reducing the impact of recreational activities on forest resources in Michigan (DNRE data).

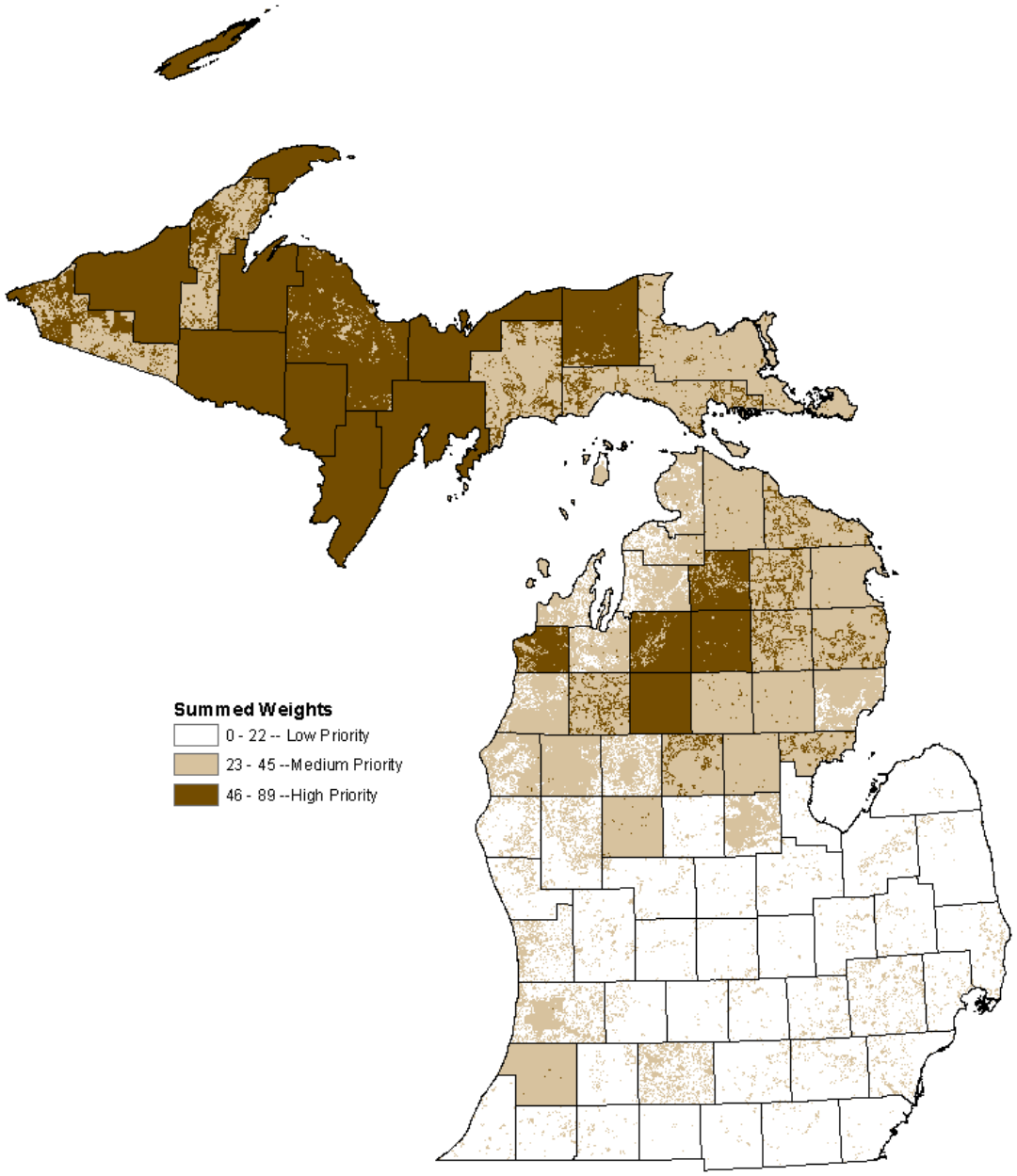


Figure 3.9. Priority areas for maintaining markets for utilization of forest products in Michigan (DNRE data).

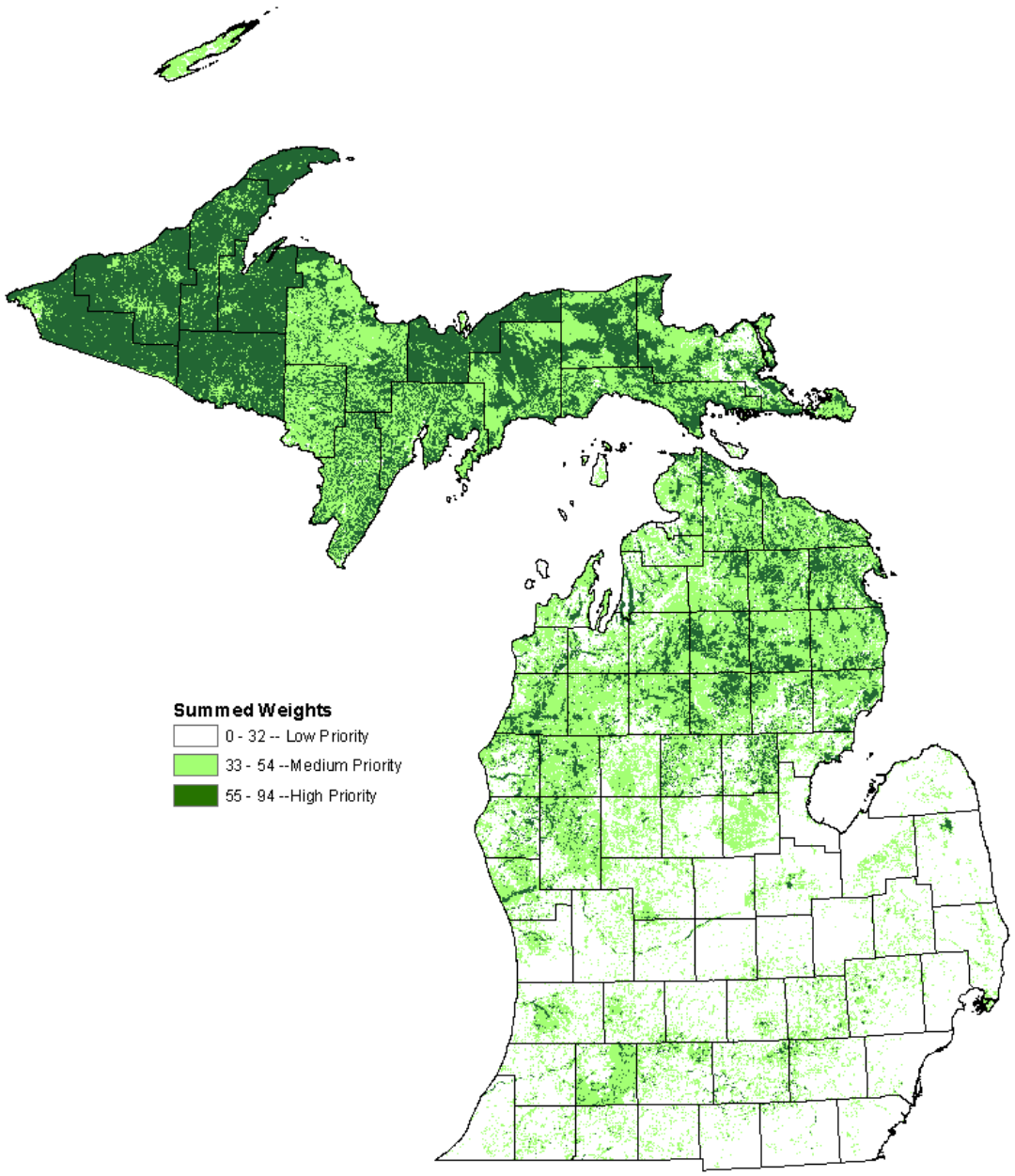


Figure 3.10. Priority areas for maintaining ecosystem services from private forestlands in Michigan (DNRE data).

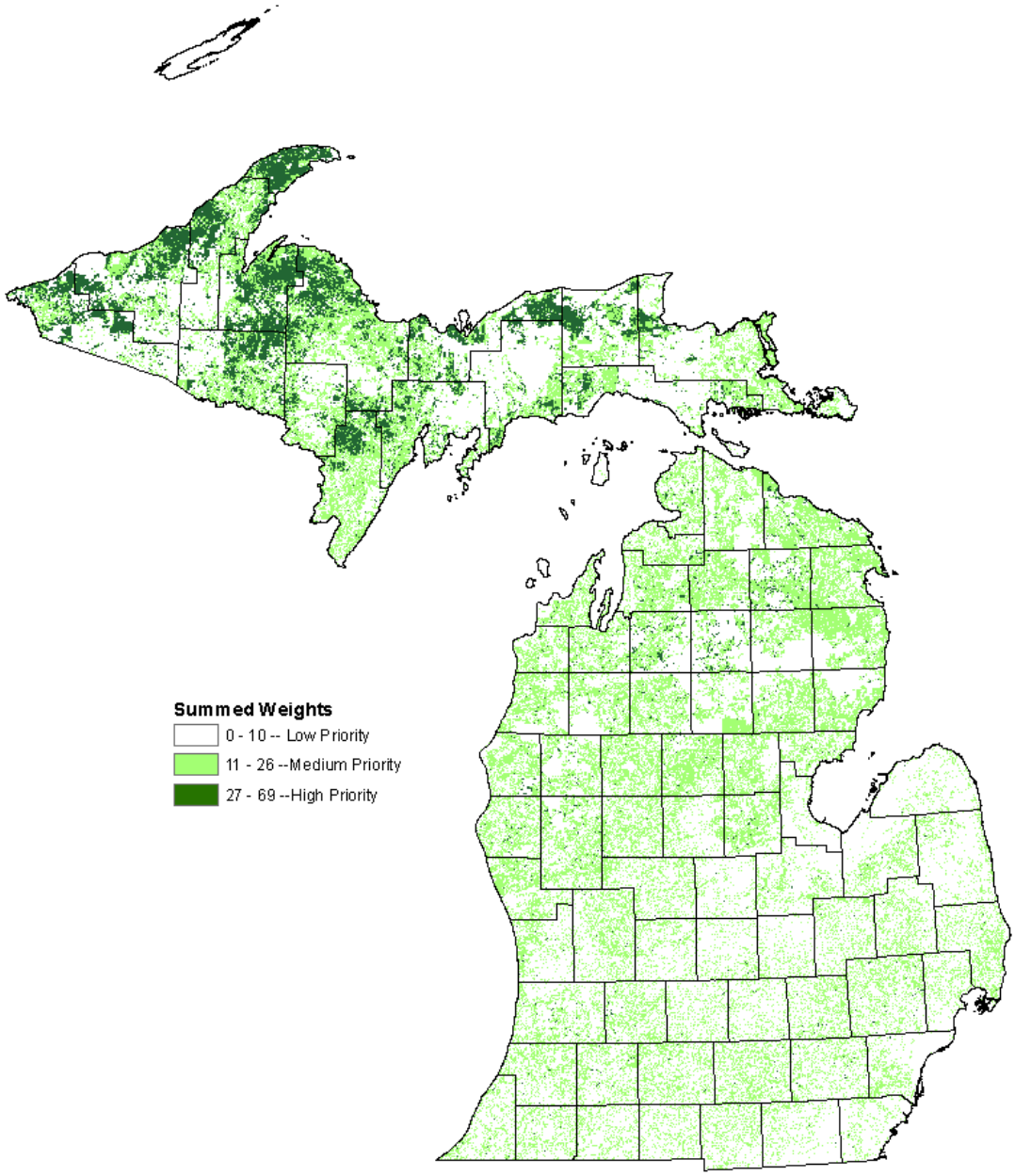


Figure 3.11. Priority areas for providing effective conservation outreach for private forestland in Michigan (DNRE data).

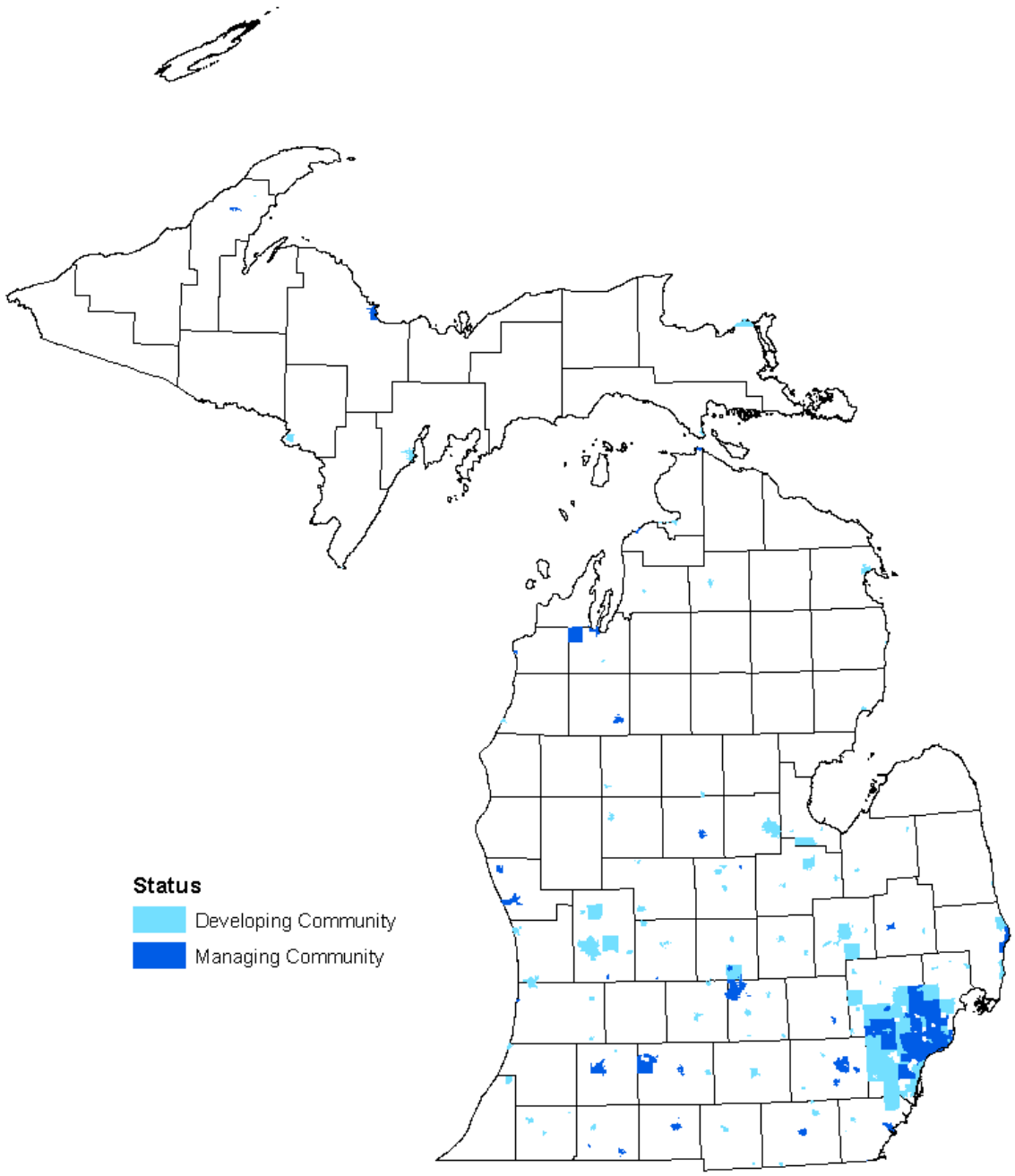


Figure 3.12. Priority areas for building local community capacity to manage urban forest resources in Michigan (DNRE data).

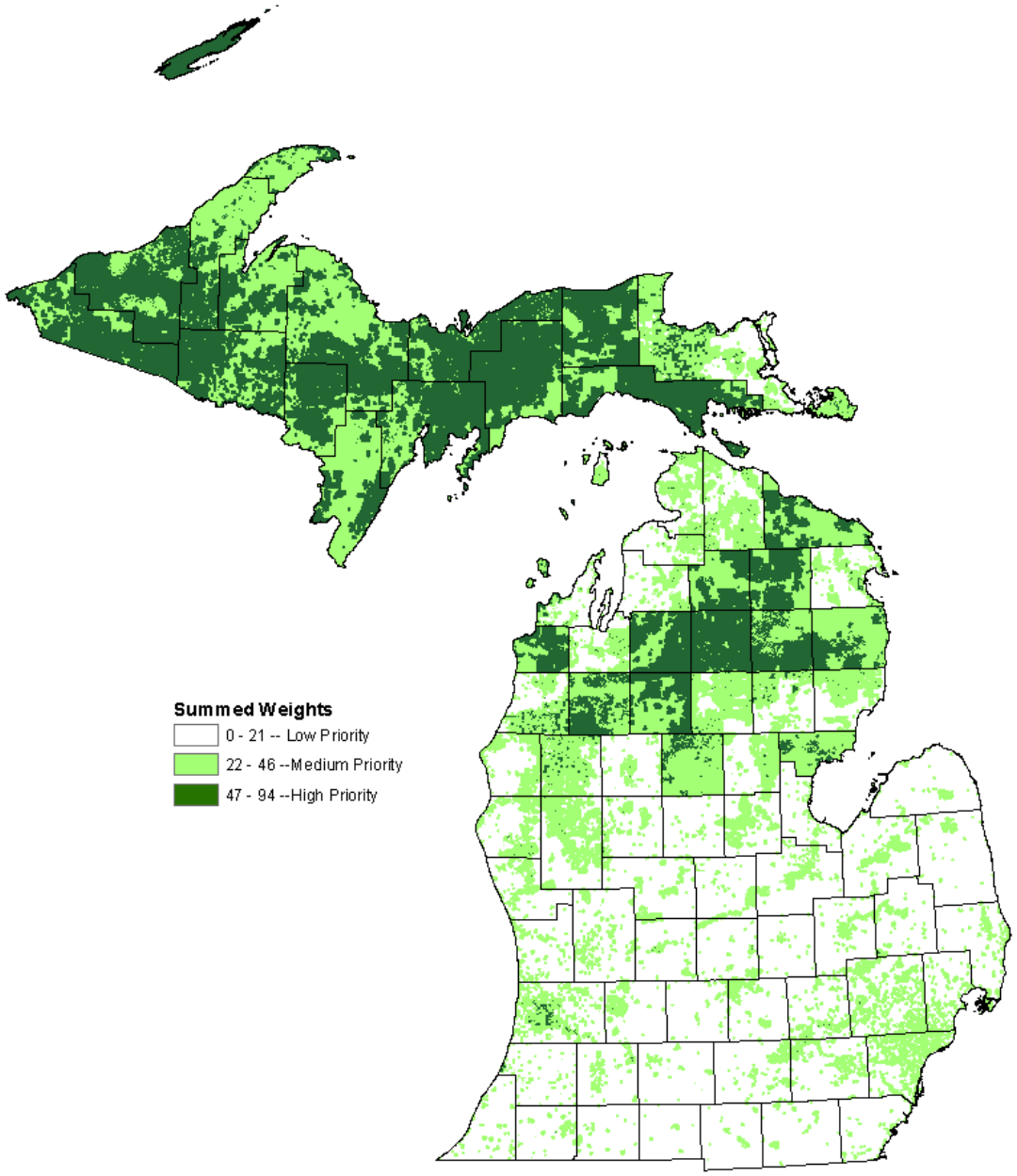


Figure 3.13. Priority areas for maintaining community quality of life and economic resiliency in Michigan (DNRE data).

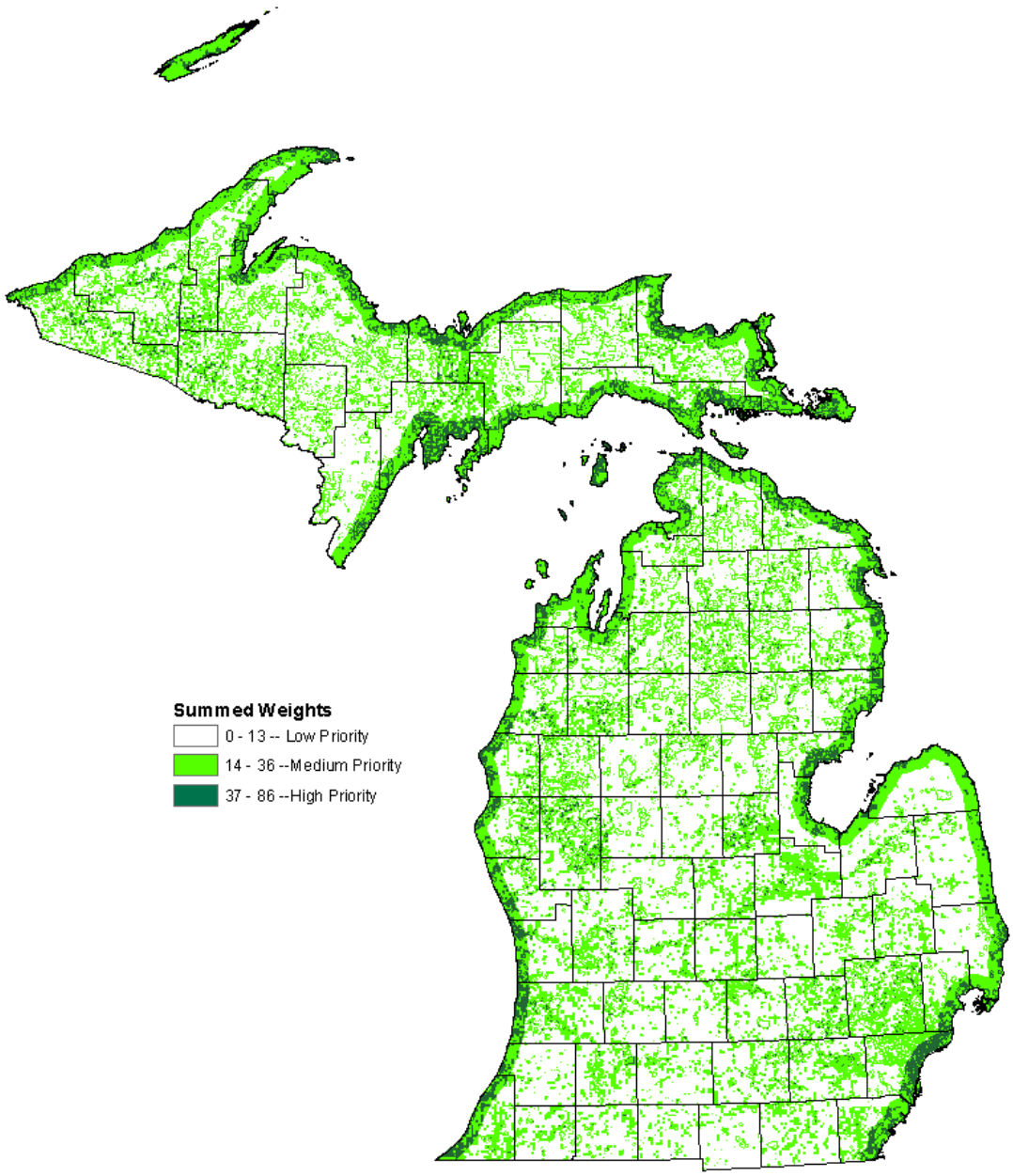


Figure 3.14. Priority areas for maintaining and enhancing scenic and cultural quality on private Michigan forestland (DNRE data).

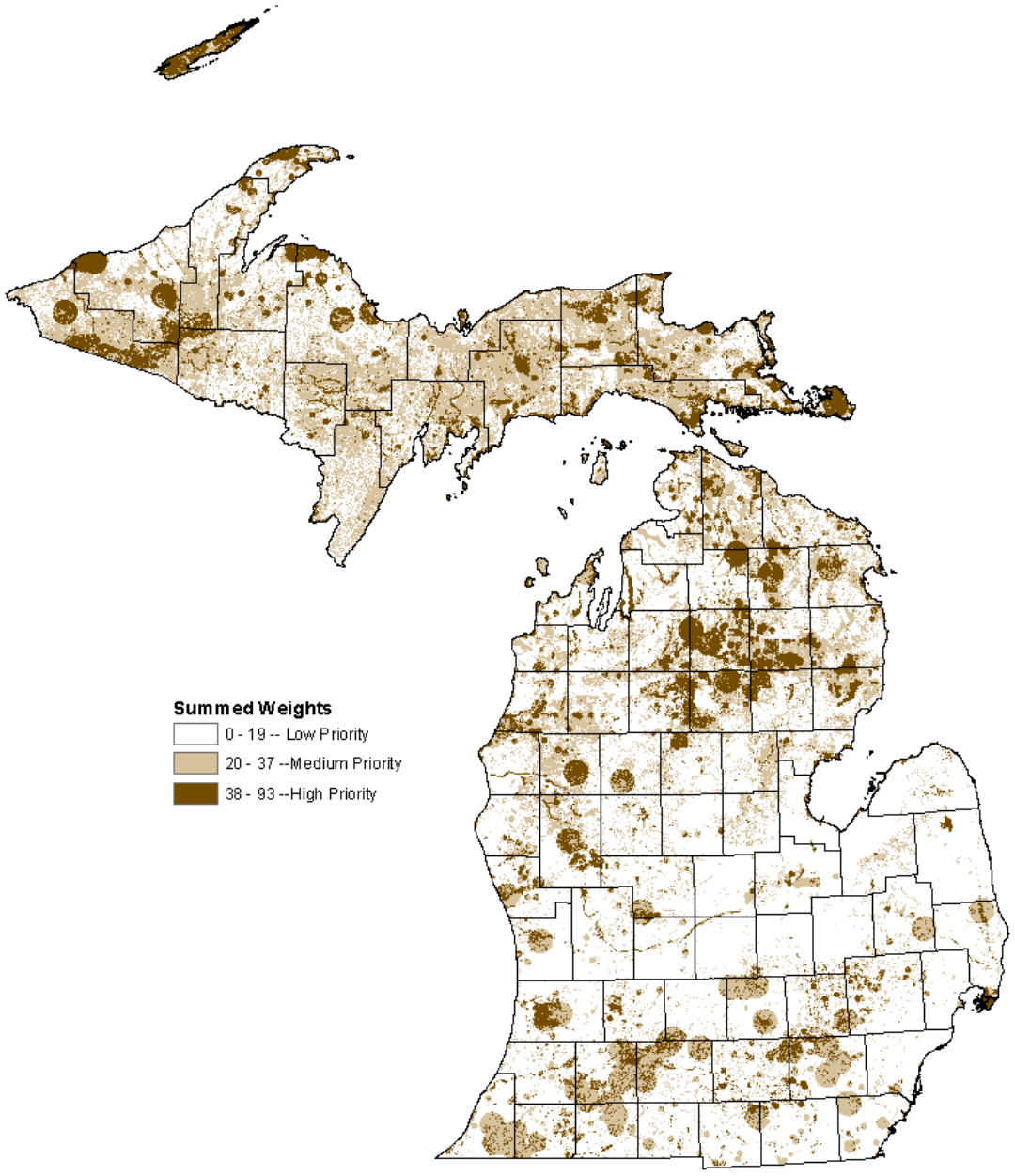


Figure 3.15. Priority areas for maintaining forested ecosystems for biodiversity and wildlife habitat in Michigan (DNRE data).

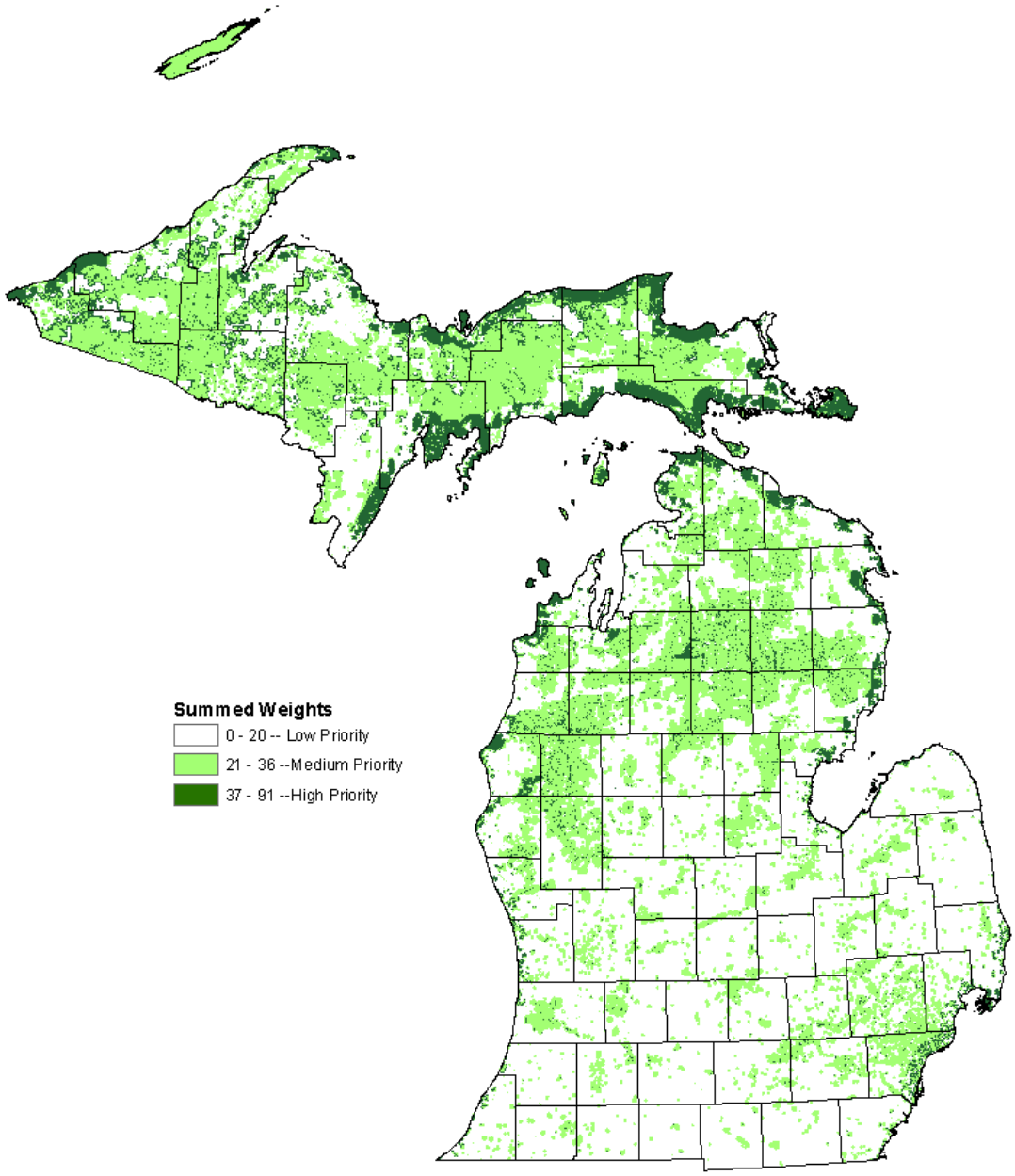


Figure 3.16. Priority areas for maintaining, and enhancing access to recreational activities on private forestland in Michigan (DNRE data).

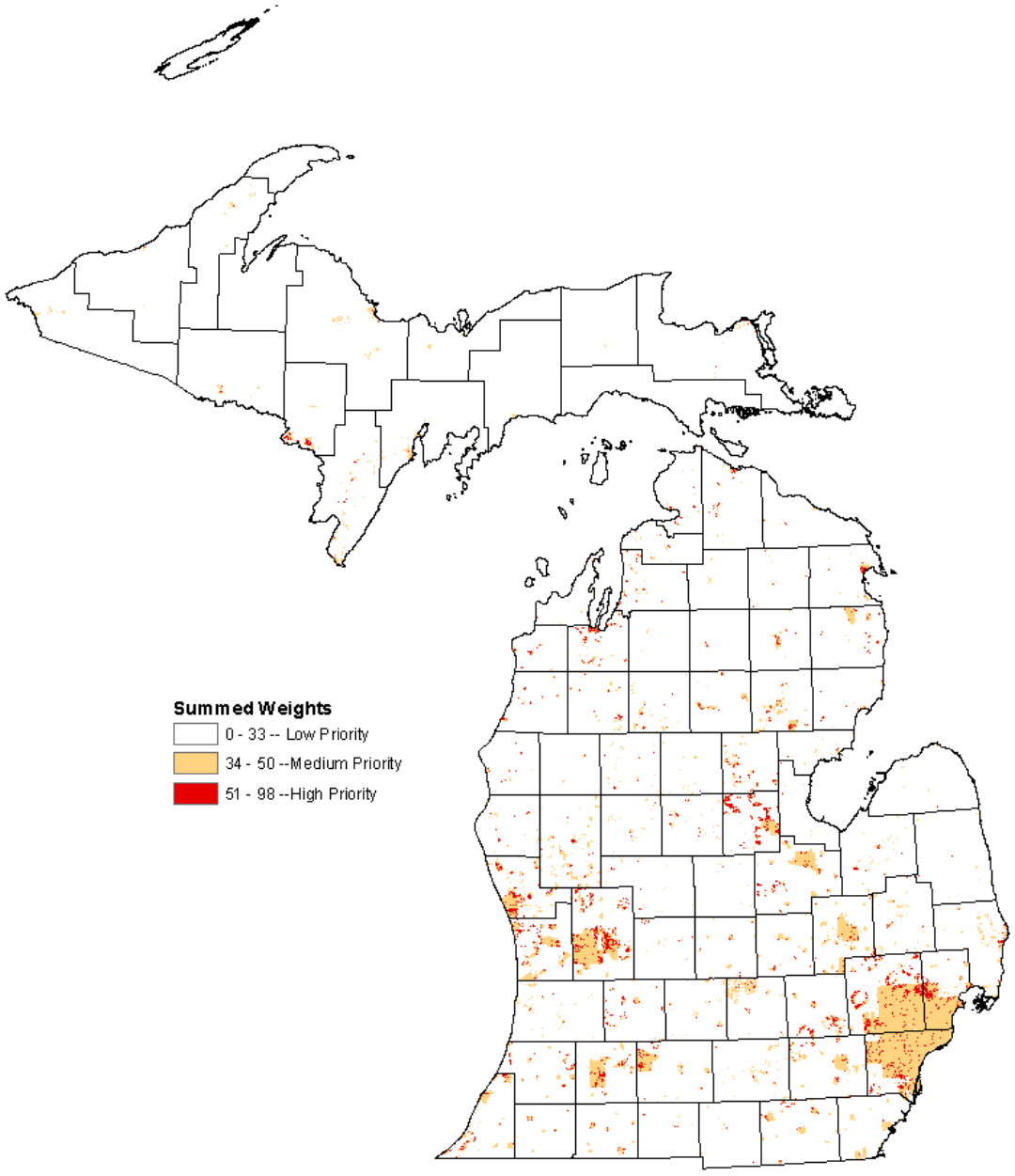


Figure 3.17. Priority areas for reforestation of urban and ex-urban areas of Michigan (DNRE data).

IV. Cooperative State and Private Forestry Programs

The purpose of this section of the Michigan Forest Resource Assessment and Strategy is to provide the linkage of five cooperative state and private forestry programs to the priority issues and strategies that are identified in Section 3. The five current cooperative forestry programs addressed in this section are:

A. Wildfire Management Program
B. Forest Health
C. Forest Stewardship
D. Forest Legacy
E. Urban and Community Forestry

These cooperative programs are both federal and state supported, but states rely heavily upon federal assistance to provide cooperative state and private forestry programs.

Table 4.1 provides a summary of the state priority issues that are currently being addressed by the State and Private Forestry Cooperative programs. These programs are the primary, but not exclusive, means by which the DNRE will implement actions to achieve the strategies that are identified in Section 3. This does not exclude the possibility for new programs or for the current programs to address other issues as future opportunities arise. The discussion for each program contains:

1. A program description;
2. An identification of the priority issues that are addressed by that program;
3. Program-specific goals that address the issues and that will help to achieve the strategies outlined in Section 3; and
4. Program-specific performance measures.

Table 4.1 also identifies multi-state priority issues that are being addressed by the State and Private Forestry Cooperative programs.

Table 4.1 State priority issues addressed by the state and private forestry cooperative programs.

National Themes and State Issues	Cooperative State and Private Forestry Programs: Forest Stewardship	Forest Legacy	Urban & Community Forestry	Forest Health	Wildfire Management	Multi-State
Conserve and Manage Working Forest Landscapes for Multiple Values and Uses						
Promote Sustainable Active Management of Private Forests	X					X
Reduce Divestiture, Parcelization, and Conversion of Private Forestlands	X	X	X			
Reduce the High Cost of Owning Private Forestland	X	X				
Protect Forests from Threats						
Maintain and Restore Aquatic Ecosystems and Watersheds	X	X				X
Reduce Threats from Invasive Species, Pests and Disease	X		X	X		X
Reduce Wildfire Risk and Improve Public Safety					X	X
Reduce Impact of Recreational Activities on Forest Resources	X					
Enhance Public Benefits from Trees and Forests						
Maintain Markets for Utilization of Forest Products	X					X
Maintain Ecosystem Services from Private Forestlands	X		X			X
Provide Effective Conservation Outreach for Private Forestlands	X	X	X	X	X	
Build Local Community Capacity to Manage Urban Forest Resources			X			
Maintain Community Quality of Life and Economic Resiliency	X		X			
Maintain & Enhance Scenic and Cultural Quality on Private Forestland	X	X				
Maintain Forested Ecosystems for Biodiversity and Wildlife Habitat	X	X				X
Maintain and Enhance Access to Recreational Activities on Private Forestlands	X	X				X
Reforestation of Urban and Ex-Urban Areas			X			

A. Wildfire Management Program

1. Program Description

Michigan's fire managers have integrated fire suppression, fire prevention, prescribed fire, and fire equipment maintenance and development into an overall wildfire management program. Maintaining cooperative agreements and strong working relationships with local fire departments and the federal wildfire agencies in Michigan is critical the success of the program.

Wildfires regularly place at risk the lives and property of the citizens of Michigan, and prescribed fire plays a role in mitigating the risk of hazardous fuels and in restoring and maintaining fire-adapted ecosystems. Where fire is required to maintain these ecosystems, it is applied in a manner that can be safely controlled while also accomplishing land management objectives.

Most Michigan wildfires are caused by humans, these fires occur close to where people live and recreate. Fire prevention is a key aspect of Michigan's wildfire management program. Prevention efforts focus on stopping avoidable fires and educating individual homeowners on how to protect their property. Assistance is given to communities for improving wildfire protection planning to reduce the risk of wildfire.

The backbone of Michigan's wildfire suppression is a force of highly trained fire fighters outfitted with modern and specialized heavy firefighting equipment. Much of the equipment is engineered, fabricated, and maintained by DNRE employees at repair shops and the Michigan Forest Fire Experiment Station. Department aircraft are flown by DNRE pilots for fire detection purposes. These detection flights provide early warning of fires and an accurate description of its location and behavior.

2. Program Priority Issues

The following priority issues from Section III are germane to the wildfire management program:

Theme 2: Protect Forests from Threats

- Reduce Wildfire Risk and Improve Public Safety

Theme 3: Enhance Public Benefits from Trees and Forests

- Issue 3: Provide Effective Conservation Outreach for Private Forestlands

3. Program-Specific Goals

The Wildfire Management Program has the following goals to address each strategic theme and priority issue. Program emphasis will adapt as opportunities and conditions change.

Theme 2: Protect Forests from Threats

Issue 3: Reduce Wildfire Risk and Improve Public Safety

- Prevent wildfires from becoming a threat to homes, infrastructure, and natural and cultural resources throughout the wild lands of Michigan and particularly in high risk locations.
- Increase the number of communities that have developed and implemented Community Wildfire Protection Plans.
- Maintain a sufficient force of DNRE employee and cooperator firefighters trained to national standards capable of responding to wildfires.
- Recruit and train enough staff to maintain a minimum of four Type 3 Incident Management Teams.
- Develop and maintain a radio communication network to provide safe and effective wildfire incident management.
- Maintain a sufficient force of specialized firefighting equipment to capable of responding to wildfires.
- Continue to acquire and provide excess military property to local fire departments for use in their wildfire suppression efforts.
- Work with both the United States Forest Service and Michigan State University to maintain a statewide network of automated weather stations.
- Utilize prescribed fire to manage fire-dependent ecosystems, reduce hazardous fuels, and achieve silvicultural prescriptions, create and maintain habitat, and concurrently provide fire fighter training and certification opportunities.
- Advance ability to predict wildfire behavior and manage wildfire incidents.
- Provide rapid initial attack on wildfires and hold wildfires under 10 acres in size with initial attack resources.
- Reduce the number of accidental wildfire ignitions.

Theme 3: Enhance Public Benefits from Trees and Forests

Issue 3: Provide Effective Conservation Outreach for Private Forestlands

- Increase public safety by providing Firewise education.
- Provide specialized training and (when appropriate) fire investigation information to cooperating law enforcement staff, seeking ways to enhance the ability of DNRE-FMD staff to provide a higher level of investigative and law enforcement capability.

4. Program-Specific Performance Measures

The following performance measures will be used to assess progress in attaining program goals:

- Number of new or revised CWPP's completed.
- Number of fire prevention and Firewise training sessions conducted.
- Number of DNRE and local fire department staff trained.
- Number of automated weather stations in service.
- Number of prescribed fires conducted.
- Number of Type 3 Incident Management Teams maintained.
- Percentage of wildfires contained with initial attack forces.
- Number of pieces of excess military property acquired.

B. Forest Health Program

1. Program Description

The Cooperative Forest Health Program was authorized by the Cooperative Forestry Assistance Act of 1978 (PL 95-313) and amended by the 1990 Farm Bill (PL 101-624). The Cooperative Forest Health Program assists states in conducting forest health management activities on non-federal forest lands to achieve healthy sustainable forests.

The Cooperative Forest Health Program provides states with federal funds to detect, monitor, and evaluate forest health conditions on state and private lands. These federal funds enable states to collect forest health data in a standardized manner so that this data is compatible with data from other states in the region. The standardization and compatibility ensures that the information collected by the states and given to the Forest Service is valid for regional reporting.

The purpose of the Cooperative Forest Health Program in Michigan is to detect, identify, and evaluate: population trends of pests known to cause serious damage; the impact of biotic or abiotic agents; and the cause of health problems on tree species or sites of concern.

2. Program Priority Issues

The following priority issues from Section III are germane to the forest health program:

Theme 2: Protect Forests from Threats

- Reduce Threats from Invasive Species, Pests and Disease

Theme 3: Enhance Public Benefits from Trees and Forests

- Issue 3: Provide Effective Conservation Outreach for Private Forestlands

3. Program-Specific Goals

The Forest Health Program has the following goals to address each strategic theme and priority issue. Program emphasis will adapt as opportunities and conditions change.

Theme 2: Protect Forests from Threats

Issue 2: Reduce Threats from Invasive Species, Pest and Disease

- Assess the current threat, status, and distribution of invasive insects, plants, and animals.
- Enhance capacity to detect, report, and respond the newly detected introductions.
- Facilitate the implementation of science-based actions that eradicate or slow the establishment and spread of invasive insects, plants, and animals.

Theme 3: Enhance Public Benefits from Trees and Forests

Issue 3: Provide Effective Conservation Outreach for Private Forestlands

- Provide educational opportunities and products via cooperative programs to appropriate audiences, both professional and public, and across both urban and rural demographics.

4. Program-Specific Performance Measures

The following performance measures will be used to assess progress in attaining program goals:

- Acres of forestland where pests known to cause serious damage are detected and identified;
- Acres protected by rapid response activities, including impact assessments and, when necessary, treatment and follow-up evaluations.

Forest health monitoring will be used to conduct aerial and ground surveys using survey procedures in support of regional and national FHM activities. National aerial survey standards will be used to conduct aerial and ground surveys. Acres surveyed annually will be reported to USFS Northeastern Area by December 15th each year.

C. **Forest Stewardship Program**

1. Program Description

The Forest Stewardship Program encourages private, non-industrial forest owners to sustainably manage their land and to utilize a landscape scale approach to land management, protection, and wise use. This work is accomplished thorough the provision of individual, comprehensive Forest Stewardship plans, by technical guidance to forest landowners, by providing up-to-date training and information to professionals and landowners, and through an array of partnerships.
The Forest Stewardship Program is authorized by the Cooperative Forestry Assistance Act of 1978, as amended, 16 U.S.C. 2103A.

This program fosters partnerships with citizens and other stakeholders that multiply the efforts of all resource professionals and conservation experts. In this way, we strive to maximize public benefits from forests while meeting the challenges of providing individual forest owners the technical assistance to make sound resource decisions.

The purpose of the Forest Stewardship Program is to:

- Encourage non industrial private forest owners to manage their forest land in a sustainable manner.
- Provide technical assistance to private forest owners so they can make informed decisions regarding the management of their forest land
- Provide information about incentives to forest land owners which encourage the retention of their forest land, such as the tax laws that effect forest owners, and credits for carbon sequestration.
- Provide outreach and education opportunities to non industrial private forest owners, and the public, so they can better understand the values in forests, landscapes and how to manage them sustainably for the benefits they provide to society.
- Encourage a sound understanding of forest systems, landscapes, forestry practices, and forest ecosystem services so that well-informed decisions can be made.

Michigan's Forest Stewardship Program will specifically seek to foster agency and organizational cooperation to achieve Non-Industrial Private Forest management goals. A partnership among state, federal, and local natural resource agencies, universities and colleges, and the private sector will maximize assistance for landowners and accomplishments on the land.

2. Program Priority Issues

The following priority issues from Section III are germane to the forest stewardship program:

Theme 1: Conserve and Manage Working Forest Landscapes for Multiple Values and Uses

- Issue 1: Promote Sustainable Active Management of Private Forests
- Issue 2: Reduce Divestiture, Parcelization, and Conversion of Private Forestlands
- Issue 3: Reduce the High Cost of Owning Private Forestland

Theme 2: Protect Forests from Threats

- Issue 1: Maintain and Restore Aquatic Ecosystems and Watersheds
- Issue 2: Reduce Threats from Invasive Species, Pests and Disease
- Issue 4: Reduce Impact of Recreational Activities on Forest Resources

Theme 3: Enhance Public Benefits from Trees and Forests

- Issue 1: Maintain Markets for Utilization of Forest Products
- Issue 2: Maintain Ecosystem Services from Private Forestlands
- Issue 3: Provide Effective Conservation Outreach for Private Forestlands
- Issue 5: Maintain Community Quality of Life and Economic Resiliency
- Issue 6: Maintain and Enhance Scenic and Cultural Quality on Private Forestland
- Issue 7: Maintain Forested Ecosystems for Biodiversity and Wildlife Habitat
- Issue 8: Maintain and Enhance Access to Recreational Activities on Private Forestlands

3. Program-Specific Goals

Forest Stewardship goals are achieved through work with public and private partners, taking advantage of existing programs and efforts. The Forest Stewardship program has the following goals to address each strategic theme and priority issue. Program emphasis will adapt as opportunities and conditions change.

Theme 1: Conserve and Manage Working Forest Landscapes for Multiple Values and Uses

Issue 1: Promote Sustainable Active Management of Private Forests

- Provide information to private forest landowners to promote sustainable forest management, forest certification programs, and the development of comprehensive Forest Stewardship plans for their properties.
- Utilize cost share opportunities and partner with groups that are assisting private forest landowners to encourage the sustainable management of private forestland.
- Create regional groups that examine the landscapes in which private forest owners exist, and to provide information about management recommendations that can be provided to professional plan writers and with landowners for inclusion in Forest Stewardship plans, and encouraged in other forest management plans.
- Direct outreach and education efforts to professional plan writers and with landowners that emphasize biomass production best management practices.

Issue 2: Reduce Divestiture, Parcelization and Conversion of Private Forestlands

- Promote the long-term maintenance of working private forestland through outreach with other partners and through participation in tax incentive programs, such as the Commercial Forest and the Qualified Forest Property Tax programs. And.

- Provide information and technical assistance to private forestland owners regarding the intergenerational transfer of their lands that will help to enable them to make informed decisions and that will help to transfer their land ethic values to the next generation.
- Utilize ecosystem market systems to provide an incentive for retaining forest land.

Issue 3: Reduce the High Cost of Owning Private Forestland

- Provide outreach and education materials to forest owners to inform them about cost effective strategies to maintain their forestland and reduce costs.
- Encourage landowner coalitions/cooperatives to provide technical assistance and to facilitate economies of scale for site preparation, tree planting, and wildlife habitat management.
- Partner with NRCS and other agencies to encourage new cost share opportunities for private forestland owners to offset the costs of forestland management.
- Facilitate outreach and education regarding reducing high inheritance costs that impact the intergenerational transfer of forestland.
- Streamline forest landowner access to cost-share programs and allow for a cumulative program.

Theme 2: Protect Forests from Threats

Issue 1: Maintain and Restore Aquatic Ecosystems and Watersheds

- Focus the development of Forest Stewardship Management Plans and reforestation and aforestation efforts where there are Water Resource Division approved watershed plans or USFS-identified Priority Watersheds for Restoration.
- Emphasize Non-Point Source identified priority watersheds in landscape assessments in outreach and education efforts to landowners, plan writers, and community leaders.
- Encourage distribution, reference, and use of the DNRE Sustainable Soil and Water Quality Practices of Forest Land (MDNR and DEQ 2009) through outreach and education efforts and in Forest Stewardship Management Plans.

Issue 2: Reduce Threats from Invasive Species, Pests and Disease

- Provide invasive species and forest pest, and disease information to professional forest stewardship plan writers and private forestland owners through educational products and outreach.
- Train foresters and loggers on known and upcoming invasive species threats so that they may serve as a front line of detection.
- Train foresters and loggers in proper sanitation techniques to minimize unintended invasive introductions during harvesting operations.

Issue 3: Reduce Impact of Recreational Activities on Forest Resources

- Assist in distributing comprehensive information on control and prevention of invasive species, especially in relation to recreational activities that serve as vectors to their introduction and spread.

Theme 3: Enhance Public Benefits from Trees and Forests

Issue 1: Maintain Markets for Utilization of Forest Products

- Support the maintenance of existing and traditional markets by facilitating the completion of management plans and the production of wood fiber from private forestland.
- Encourage the development of ecosystem services markets through grants, an ecosystem services bank, or partnerships to provide economic incentives to private forest owners for the sustainable long-term management of their forest land.
- Assist private landowner participation and support of biomass energy markets and forest certification systems through incorporation in Forest Stewardship Plans.

Issue 2: Maintain Ecosystem Services from Private Forestlands

- Facilitate the understanding and appreciation of ecosystem services markets by both landowners and the public.
- Enable private forest owners to participate in the carbon credit market through the Working Forest Carbon Offset project.
- Include information regarding forests' carbon sequestering and cycling capacity, anticipated impacts of climate change, and adaptive actions to mitigate adverse impacts of climate change in Forest Stewardship Management Plans.

Issue 3: Provide Effective Conservation Outreach for Private Forestlands

- Continue to offer leadership and guidance for the Non-Industrial Private Forest Coalition networking effort.
- Provide outreach and education choices for landowners and forestry professionals, in cooperation with partners, that emphasize the full range of sustainable forestry management options for timber and habitat production.

Issue 4: Maintain Community Quality of Life and Economic Resiliency

- Use outreach and education to help local decision makers understand the economic benefits of forested lands, including new markets.

Issue 5: Maintain and Enhance Scenic and Cultural Quality on Private Forestland

- Provide information and technical guidance to private forestland owners to encourage the enrollment of scenic forestland in the Commercial Forest Program.
- Provide information and technical guidance to private forestland owners to encourage the enrollment of scenic forestland in the Qualified Forest Program.

Issue 6: Maintain Forested Ecosystems for Biodiversity and for Wildlife Habitat

- Incorporate information about biodiversity values into Forest Stewardship and other forest management plans, as well as information about threatened and endangered species, so that landowners can make informed decisions.

Issue 7: Maintain and Enhance Access to Recreational Activities on Private Forestlands

- Provide information about the Commercial Forest Program to private forestland owners to gain public access rights for dispersed recreation.

4. Program-Specific Performance Measures

The following performance measures will be used to assess progress in attaining program goals:

- Number of new or revised Forest Stewardship Management Plans completed.
- Number of new or revised Forest Stewardship Management Plans completed in important forest resource areas.
- Number of acres covered by current Forest Stewardship Management Plans (cumulative).
- Number of landowners receiving technical assistance from Forest Stewardship and other assistance programs.
- Number of landowners participating in educational programs sponsored by the Forest Stewardship and other assistance programs.
- Locations of new Forest Stewardship plans, in the Spatial Analysis Map 2 format.
- Monitor as percentage of Forest Stewardship Plans to determine the extent of implementation.

D. Forest Legacy Program

1. Program Description

The purpose of the Forest Legacy Program (FLP) is to ascertain and protect environmentally important forest areas that are threatened by conversion to non-forest uses. The FLP seeks to promote forestland protection and other conservation opportunities. Such purposes shall include the protection of important scenic, cultural, fish, wildlife and recreational resources, riparian areas and other ecological values. Traditional forest uses, including timber management, as well as hunting, fishing, hiking, and similar recreational uses are consistent with the purposes of the FLP. Both purchased and donated lands and interests in lands through the use of conservation easements and fee-simple purchase are used to acquire forested land meeting FLP purposes from willing sellers or donors.

2. Program Priority Issues

The following priority issues from Section III are germane to the Forest Legacy Program:

Theme 1: Conserve and Manage Working Forest Landscapes for Multiple Values and Uses

- Reduce Divestiture, Parcelization, and Conversion of Private Forestlands
- Reduce the High Cost of Owning Forestland

Theme 2: Protect Forests from Threats

- Maintain and Restore Aquatic Ecosystems and Watersheds
- Maintain and Restore Terrestrial Ecosystems on Forestlands

Theme 3: Enhance Public Benefits from Trees and Forests

- Provide Effective Conservation Outreach for Private Forestlands
- Maintain & Enhance Scenic and Cultural Quality on Private Forestland
- Provide for Biodiversity and Wildlife Species on Private Forestland
- Maintain, and Enhance Access to Recreational Activities on Private Forestlands

Michigan has concluded that the Forest Legacy Program (FLP) will be implemented according to the current Assessment of Need (AON) approved on February 20, 2004, which is hereby incorporated into this document by reference. A copy of the State Lead Agency designation letter, the AON, and the AON approval letter can be found under the Forest Legacy Program section at www.michigan.gov/privateforestland or by contacting the following office: Michigan Forest Legacy Program, Forest Management Division, Department of Natural Resources and Environment, PO Box 30452, Lansing, MI 48909-7952.

3. Program-Specific Goals

Current goals for the Forest Legacy Program are provided in the Michigan Forest Legacy Program Assessment of Need (Michigan Department of Natural Resources 2003). Program emphasis will adapt as opportunities and conditions change.

4. Program-Specific Performance Measures

Current performance measures for the Forest Legacy program are provided in the Michigan Forest Legacy Program Assessment of Need (Michigan Department of Natural Resources 2003).

E. Urban and Community Forestry Program

1. Program Description

The Michigan Department of Natural Resources and Environment (DNRE), Urban and Community Forestry (UCF) program provides technical, financial, and educational assistance to nearly 7.5 million urban residents in over 1,300 communities. This broad-based assistance program builds

awareness and capacity of communities, organizations, and citizens, to support informed decision making about proper management of urban forest resources for the numerous benefits they provide.

Assistance is provided to a variety of partners throughout the state including: local units of government, community groups, non-profit organizations, schools/universities, churches, volunteers, tribes, businesses, and individuals. Additionally, Michigan's UCF program has created and sustained several important partnerships to promote training, mentoring, and other financial opportunities related to urban and community forestry.

2. Program Priority Issues

The following priority issues from Section III are germane to the urban and community forestry program:

Theme 1: Conserve and Manage Working Forest Landscapes for Multiple Values and Uses

- Issue 2: Reduce Divestiture, Parcelization and Conversion of Private Forestlands

Theme 2: Protect Forests from Threats

- Issue 2: Reduce Threats from Invasive Species, Pests and Disease

Theme 3: Enhance Public Benefits from Trees and Forests

- Issue 2: Maintain Ecosystem Services from Private Forestlands
- Issue 3: Provide Effective Conservation Outreach for Private Forestlands
- Issue 4: Build Local Community Capacity to Manage Urban Forest Resources
- Issue 5: Maintain Community Quality of Life and Economic Resiliency
- Issue 9: Reforestation of Urban and Ex-Urban Areas

3. Program-Specific Goals

The Urban and Community Forestry Program has the following goals to address each strategic theme and priority issue. Program emphasis will adapt as opportunities and conditions change.

Theme 1: Conserve and Manage Working Forest Landscapes for Multiple Values and Uses

Issue 2: Reduce Divestiture, Parcelization and Conversion of Private Forestlands

- Minimize and reduce the conversion of forested properties to non-forest land uses within urban and community areas.
- Increase awareness and understanding of the need to conserve working forest landscapes among appropriate audiences (public and private) in urban and community areas.

Theme 2: Protect Forests from Threats

Issue 2: Reduce Threats from Invasive Species, Pests and Disease

- Increase awareness, identification and reporting of various tree disease and insect problems throughout urban and community areas of the state.

Theme 3: Enhance Public Benefits from Trees and Forests

Issue 2: Maintain Ecosystem Services from Private Forestlands

- Promote more planting of trees on private and public urban property as a means of achieving improved environmental quality.

Issue 3: Provide Effective Conservation Outreach for Private Forestlands

- Target all priority areas for additional UCF (specifically tree planting) outreach and education efforts/assistance.

Issue 4: Build Local Community Capacity to Manage Urban Forest Resources

- Increase the number of communities that are actively and sustainably managing their urban and community forest resources as defined by the USDA Forest Service's, Community Accomplishment Reporting System (CARS).
- Increase the population of citizens living in communities that are defined as 'Managing' in CARS.

Issue 5: Maintain Community Quality of Life and Economic Resiliency

- Ensure that urban and community forests are recognized and utilized for their contributions toward improving community quality of life and economic resiliency.
- Encourage communities to pursue TreeCity USA designation.
- Provide communities with technical, educational and financial assistance to initiate or enhance local capacity to deliver urban and community forestry programs

Issue 9: Reforestation of Urban and Ex-Urban Areas

- Replace and expand tree cover in urban and ex-urban areas that have experienced the greatest loss of trees due to issues such as: insect/disease (e.g. emerald ash borer), urban sprawl and development, and storm damage.
- Facilitate volunteer tree planting initiatives in all priority areas.

4. Program-Specific Performance Measures

The following performance measures will be used to assess progress in attaining program goals:

- Number of local government officials receiving forest land use planning training.
- Number of communities classified as having a "Developing" or "Managing" status for their Urban and Community Forestry program
- Population living in communities classified as either "Developing" or "Managing"
- Amount of funding distributed to communities in "Developing" status
- Number of grants issued to communities in "Developing" status
- Number of communities initiating a new/first time: tree ordinance, inventory, management plan, tree board or employing professional UCF staff
- Percent change in canopy cover (community level information based on availability of current, local inventory/assessment)
- Percent change in species diversity (community level information based on availability of current, local inventory/assessment)
- Total number of trees planted in priority areas
- Total number of tree planting grants awarded in all priority areas
- Total funds expended from UCF program grants in all priority areas
- Total number of volunteer hours contributed to tree planting in all priority areas
- Number of communities certified with the Tree City USA classification
- Population living in communities certified with the Tree City USA classification
- Total number of Tree City USA communities planting more trees than removing
- Total number of trees planted vs. removed in Tree City USA communities

Appendix A. List of Organizations that Participated in Development of the Michigan Resource Assessment and Strategy.

The following divisions of the Michigan Department of Natural Resources and Environment developed the Michigan Resource Assessment and Strategy:

- Fisheries Division
- Forest Management Division
- Water Resource Division
- Wildlife Division

The following external organizations participated in the development of the Michigan Resource Assessment and Strategy:

- Forest Stewardship Program State Advisory Committee
- Michigan DNRE Forest Management Advisory Committee
- Michigan State University Extension
- Michigan Technical Committee
- Michigan Urban and Community Forestry Council
- USDA, Hiawatha National Forest
- USDA, Huron-Manistee National Forest
- USDA, Ottawa National Forest
- USDA, Natural Resources Conservation Service
- U.S. Department of Interior, Fish and Wildlife Service

Appendix B. Overview of Geospatial Analysis for Priority Issues.

Geospatial analysis, or simply spatial analysis, is a way of qualifying and quantifying how various types of information (e.g., natural resource, environmental, cultural, etc.) are related geographically and expressed as a visual representation on a map. Spatial analysis involves geospatial layers. A layer is a thematic set of spatial data representing one type of information, such as ownership, land use, roads, census tracts, streams, etc. The geospatial data layers that were used in this analysis are described in Appendix C.

Spatial analysis can be performed in many ways. To produce the priority maps for this state assessment, a weighted overlay analysis was used. This technique involves applying a weight to each of several geospatial layers, overlaying them, and summing the weighted values of coincident pixels for all the layers. A pixel is a square unit that represents a specific spot on the ground and is the smallest unit of resolution of geographic area used in the analysis. For the Michigan assessment, all analyses were done at the 30- by 30-meter pixel size (0.22 acres).

For each priority issue, the data layers to be included and the weights assigned to each layer were determined by DNRE cooperative program leaders, working collaboratively with existing cooperative program and forestry advisory committees. Weighted values were assigned by determining the appropriate percentage of votes received out of a total of 100 points per issue. Thus, an individual weight for a particular layer is the percent contribution of that layer to the overall model output.

The weighted values for coincident pixels of the inclusive input layers were then summed resulting in values ranging from 0 to 100 percent of the maximum possible. To simplify results, the composite output index layer was classified into three classes using the Jenks' Natural Breaks method. This method uses the data to determine where breaks between classes should occur by minimizing variation within classes while maximizing variation among classes. On the maps produced, the classes are referred to as Low, Medium, and High. In addition, the range of pixel values that occur within each class are given. These values range from 0 to 100 percent of maximum possible.

Reduce Divesture and Parcelization of Private Forestland

Layers used	Weight
Development Threat (2000-2030)	26
Private Forestlands	17
Forest Patch Size	14
Conservation Easements	9
Wildland Urban Interface	8
Proximity to Public Lands	8
Timber Production	7, 4, 1
Home Starts	7, 4, 1
Population Change (2000-2007)	3, 2
Commercial Forest Lands	1

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Reduce the High Cost of Owning Forestland

Layers used	Weight
Forestland Tax Rates	33, 17, 1
Private Forestlands	18
Development Threat (2000-2030)	16
Active Forest Stewardship Plans	9
Wildland Urban Interface	8
Population Density	8
Wildfire Risk	5, 3, 1
Poverty	2
Forest Patch Size	1

Conservation Easements, Qualified Forest Lands, and Commercial Forest Lands were removed.

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Reduce Impacts of Urbanization and Conversion of Forestland

Layers used	Weight
Development Threat (2000-2030)	23
Private Forestlands	14
Population Density	11
Wildland Urban Interface	11
Proximity to Public Lands	9
Forest Patch Size	9
Urban Areas (Maryland Method)	8
Home Starts	8, 4, 1
Open Space	7

Conservation Easements, Municipal Boundaries, and Public Lands were removed.

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Provide Incentives for Private Landowners to Maintain Forestland

Layers used	Weight
Private Forestlands	22
Commercial Forest & Qualified Forest Lands	20
Forestland Tax Rates	17, 9, 1
Active Forest Stewardship Lands	15
Timber Production	9, 5, 1
Development Threat (2000-2030)	9
Wildland Urban Interface	5
Carbon Sequestration by County	3, 2, 1

Conservation Easements and Public Lands were removed.

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Promote Sustainable Active Management of Public and Private Forestlands

Layers used	Weight
Private Forestlands	20
Public Lands	18
Commercial Forest & Qualified Forest Lands	10
Timber Production	8, 4, 1
Active Forest Stewardship Plans	6.5
Timber Market	6.5, 3, 1
Conservation Easements	4
Forest Patch Size	4
Ability to Produce Clean Water	4, 2
Economic Dependence on Forest Resources	4, 2
Percent Employment in Forestry & Wood Products	4, 3, 1
Wetlands	3
Carbon Sequestration by County	2, 1
Wildland Urban Interface	2
River Corridor	1
Wildfire Risk	1
Population Change (2000-2007)	1
Community Accomplishment Reporting System	1

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Maintain and Restore Aquatic Ecosystems and Watersheds

Layers used	Weight
Wetlands	19
River Corridor	16
Aquatic Biodiversity	14
Impaired Watersheds	13, 7, 1
Ability to Produce Clean Water	9, 5, 1
Impervious Surface	8
T & E Species, Rare Communities, & Ecological Reference Areas	7
Development Threat (2000-2030)	4
Wildland Urban Interface	4
Canopy Cover	3
Nature Reserves	1
National and State Parks	1
Population Density	1

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Reduce Threats from Invasive Species, Pests and Disease

Layers used	Weight
Forest Health Risk	19
Forest Distance from Road	15, 10, 5
Campgrounds	11
Public Lands	9
Recreational Trails	9
Wildland Urban Interface	8
Wellheads and Pipelines	6
Urban Areas (Maryland Method)	5
Private Forestland	5
Forest Patch Size	5
Nursery Locations (1 mile buffer)	4
Active Forest Stewardship Plans	2
T & E Species, Rare Communities, & Ecological Reference Areas	1
Home Starts	1

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Maintain and Restore Terrestrial Ecosystems

Layers used	Weight
Public Lands	13
Threatened and Endangered Species	13
Private Forestland	11
Forest Health Risk	10
Development Threat (2000-2030)	10
Wildland Urban Interface	8
Conservation Easements	7
National & State Parks	6
Forest Patch Size	5
Nature Reserves	5
Urban Areas (Maryland Method)	5
Timber Production	4, 2
Active Forest Stewardship Plans	2
Wildfire Risk	1

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Reduce Wildfire Risk and Increase Public Safety

Layers used	Weight
Wildfire Risk	30, 25, 20, 15, 5
Communities at Risk	19, 10
Wildland Urban Interface	16
Population Density & Development Threat (2000-2030)	9
Road Locations	6
Private Forestland	6
Canopy Cover	5
Public Lands	5
Forest Health Risk	4

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Impact of Recreational Activities and Over-use of Resources

Layers used	Weight
Public Land & Proximity to Public Land	21
Recreational Trails	16
Campgrounds & Boating & Fishing Access Sites	16
Resource Damage Records	11
Road Density (UP and Northern LP only)	10, 6, 3
Development Threat (2000-2030)	7
Erosion Potential	7
Wildland Urban Interface	7
Scenic Areas	5

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Maintain Markets for Utilization of Forest Products

Layers used	Weight
Timber Markets	21, 11, 1
Timber Production	13, 7, 1
Percent Employment in Forestry & Wood Products	13, 7, 1
Commercial Forest & Qualified Forest Lands	11
Private Forestland	10
Economic Dependence on Forest Resources	10, 5, 1
Public Land & Proximity to Public Land	9
Road Surface Type	5, 3
Active Forest Stewardship Plans	4
Home Starts	3, 2, 1
Conservation Easements	1

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Maintain Ecosystem Services from Forests

Layers used	Weight
Ability to Produce Clean Water	18, 9, 1
Carbon Sequestration by County	16, 8, 1
Wetlands	15
Forest Patch Size	12
T & E Species, Rare Communities, & Ecological Reference Areas	11
Estimated Groundwater Recharge	11
Carbon Sequestration Forest Stewardship Plans	6
Aquatic Biodiversity	6
Deer Wintering Areas	2
Impaired Watersheds	2, 1
Conservation Easements	1

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Provide Effective Conservation Outreach

Layers used	Weight
Campgrounds and Boating and Fishing Access Sites	19
Private Forestlands	17
Recreational Trails	14
Conservation Easements	9
Commercial Forest & Qualified Forest Lands	7
Active Forest Stewardship Plans	7
Huntable Lands	7
Nature Reserves	7
Economic Dependence on Forest Resources	6, 3, 1
Cultural & Historic Areas	5
Proximity to Public Lands	1
T & E Species, Rare Communities, & Ecological Reference Areas	1

Public Lands were removed.

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Build Local Community Capacity to Manage Urban Forests

Layers used	Weight
Urban Areas (Maryland Method)	28
Wildland Urban Interface	21
Community Accomplishment Reporting System	17
Impervious Surface	10
Canopy Cover	10
Gases & Particulate Matter	5, 3, 1
Home Starts	5, 3, 1
Forest Distance from Road	3, 2, 1
T & E Species, Rare Communities, & Ecological Reference Areas	1

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Maintain Community Quality of Life and Economic Resiliency

Layers used	Weight
Public Lands & Proximity to Public Lands	20
Economic Dependence on Forest Resources	15, 8, 1
Timber Markets	13, 7, 1
Percent Employment in Forestry and Wood Products	13, 7, 1
Recreational Trails	12
Timber Production	8, 4, 1
Nature Reserves	6
Cultural & Historic Areas	6
Huntable Lands	5
Campgrounds and Boating and Fishing Access Sites	2

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Maintain and Enhance Scenic and Cultural Quality Associated with Forestland

Layers used	Weight
Scenic Areas	27
Public Lands & Proximity to Public Lands	19
Cultural & Historic Areas	15
Recreational Trails	9
River Corridor	9
Nature Reserves	8
Forest Patch Size	7
Campgrounds & Boating & Fishing Access Sites	6

Provide for Biodiversity and Wildlife Species on Private Forestland

Layers used	Weight
T & E Species, Rare Communities, & Ecological Reference Areas	28
Aquatic Biodiversity	15
Forest Patch Size	14
Wetlands	10
Public Lands	7
River Corridor	6
Conservation Easements	5
Deer Wintering Areas	5
Nature Reserves	5
Huntable Lands	3
Wildland Urban Interface	1
Urban Areas (Maryland Method)	1

Maintain and Enhance Access to Recreation in Forests

Layers used	Weight
Public Lands & Proximity to Public Lands	26
Recreational Trails	21
Campgrounds & Boating & Fishing Access Sites	17
Road Locations	10
Huntable Lands	9
Scenic Areas	8
Commercial Forest Lands	5
Private Forestland	4

Reforestation of Urban and Ex-Urban Areas

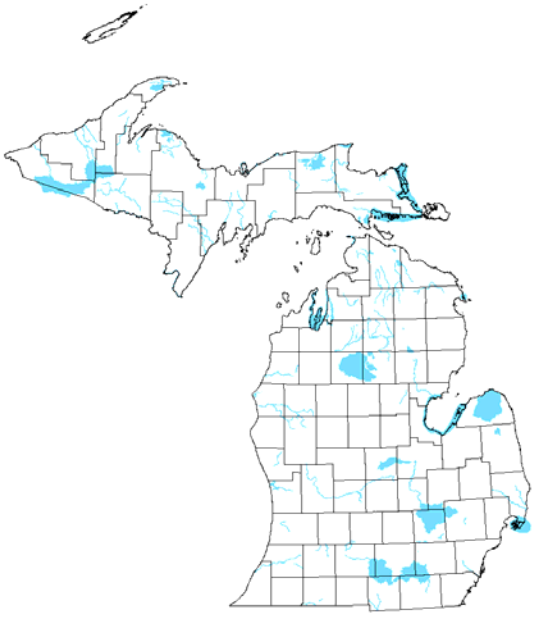
Layers used	Weight
Development Threat (2000-2030)	20
Urban Areas (Maryland Method)	20
Wildland Urban Interface	20
Oak Wilt Detection by County	20, 10
Combined Emerald Ash Borer Data	
Emerald Ash Borer Detection by County	10, 8, 6, 4
Ash Basal Area per Acre	10, 8, 6, 4

Only urban and ex-urban areas were used for this analysis which includes polygons from the following layers: Development Threat 2000-2030, Urban Areas (Maryland Method), Wildland Urban Interface, and Population Density > 1,000 per square mile.

Note: Layers with more than one weight listed were broken into classes using the Jenks' Natural Breaks method and assigned a weight depending into which class the values fell. The higher values were assigned to higher classes. It is believed that these layers have data that is not appropriately represented with a binary weighting scheme.

Appendix C. Metadata for Data Layers Utilized in the Geospatial Analysis.

Aquatic Biodiversity

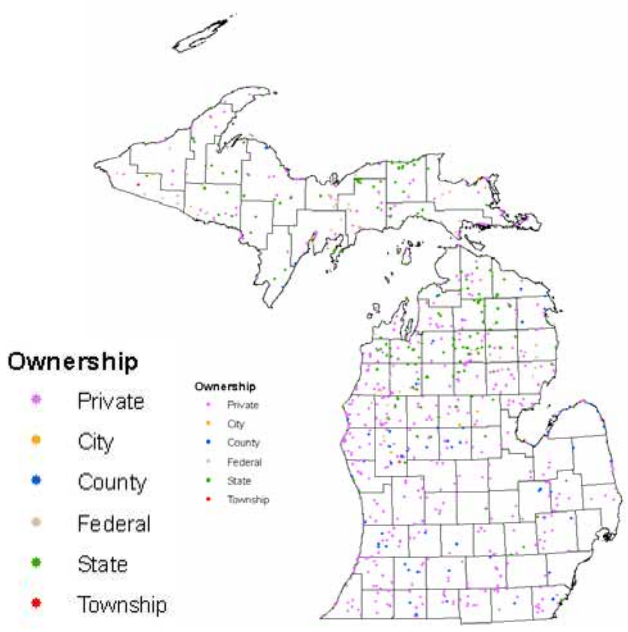


Aquatic Biodiversity areas were selected to represent different kinds of streams and lakes in all Ecological Drainage Units of the Great Lakes basin. The process used a stream classification based on size, geology, substrate, gradient, temperature (and possibly other factors). The process for selecting significant lakes was much less thorough given the lack of a lake classification. Aquatic Biodiversity was created by The Nature Conservancy (TNC) in 2003 as a vector polygon file.

Boating and Fishing Access Sites

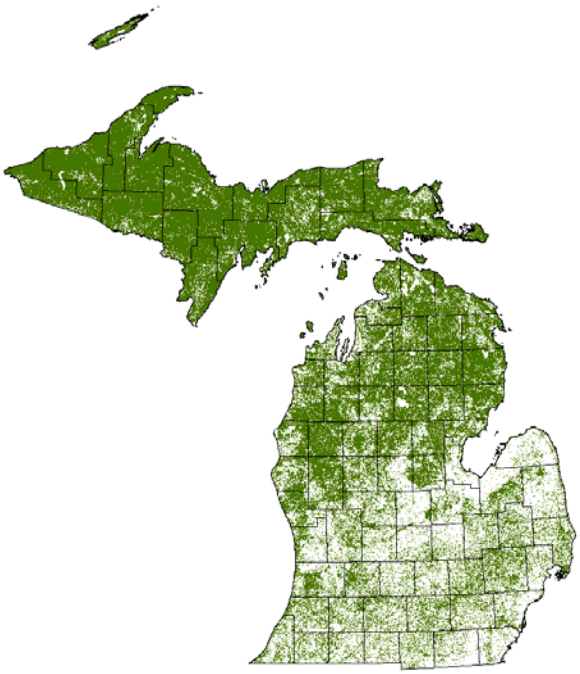
Boat Access Sites were created from a statewide effort including Global Positioning System (GPS) data and ground-truth locations. The composite dataset was created in 2005. Fishing Access Sites were generated from the Forest Compartment Review process. The Fishing Access Sites is a live dataset that is edited continually. Both the Boat and Fishing Access Sites are vector point files managed by the DNRE.

Campgrounds



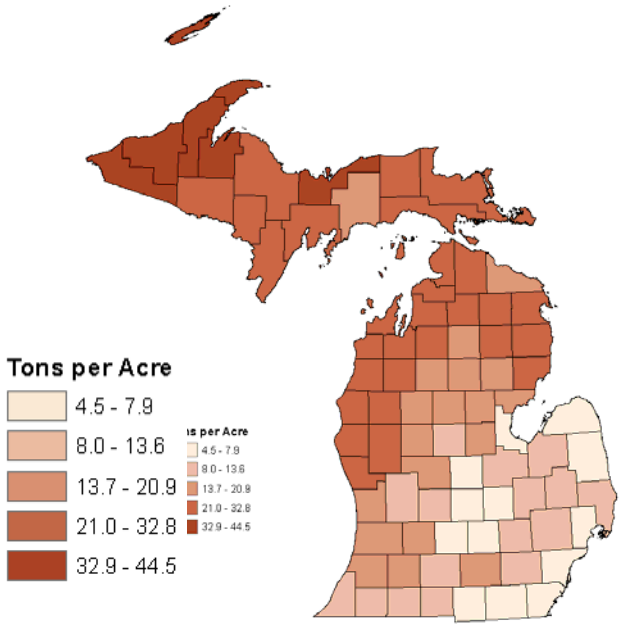
Campground locations were generated from GPS data and geocoding from physical addresses. Compilation of campground files was completed in November of 2009. Campground locations are accurate and current. Campgrounds are a vector point file.

Canopy Cover



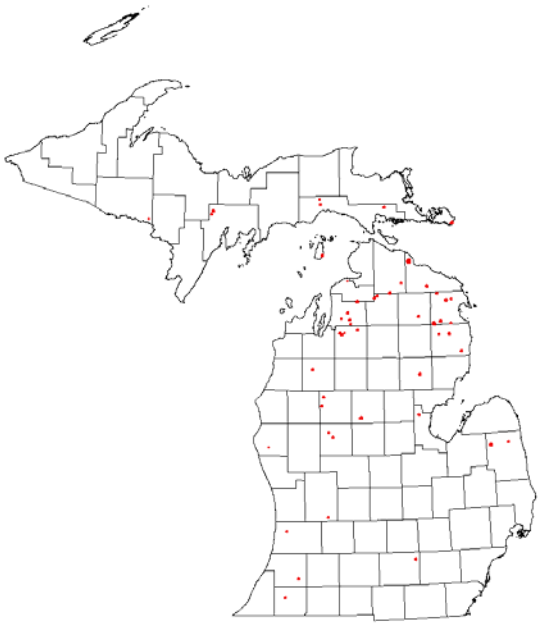
Canopy Cover data was generated by the US Forest Service from the 2001 US Geological Survey's (USGS) National Land Cover Dataset (NLCD). Canopy Cover is a 30 meter resolution raster file.

Carbon Sequestration by County



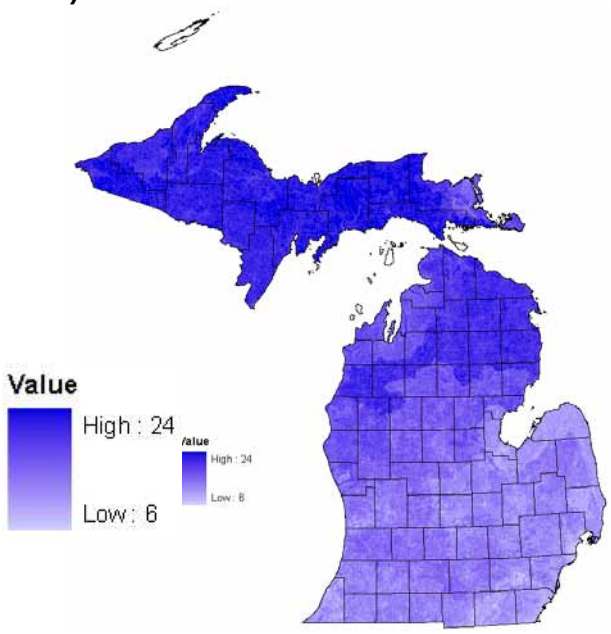
Carbon Sequestration by County was generated by the DNRE using the data available on the US Forest Service's online Evalidator Tool. Tabular data is only available by county. The data is a vector polygon file from 2004 Forest Inventory & Analysis (FIA) data.

Carbon Sequestration Plan Areas (Forest Stewardship Plans)



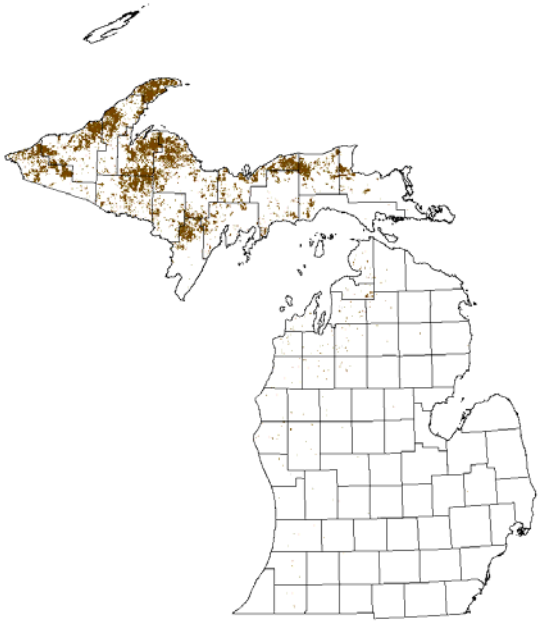
Carbon Sequestration Plan Areas were generated from the Forest Stewardship database managed by the DNRE. The data is a vector polygon file created November of 2009. For details about the carbon sequestration plan, go to the following website: http://www.michigan.gov/documents/dnr/CarbonSequestrationInMi_275110_7.pdf.

Clean Water (The Ability to Produce)



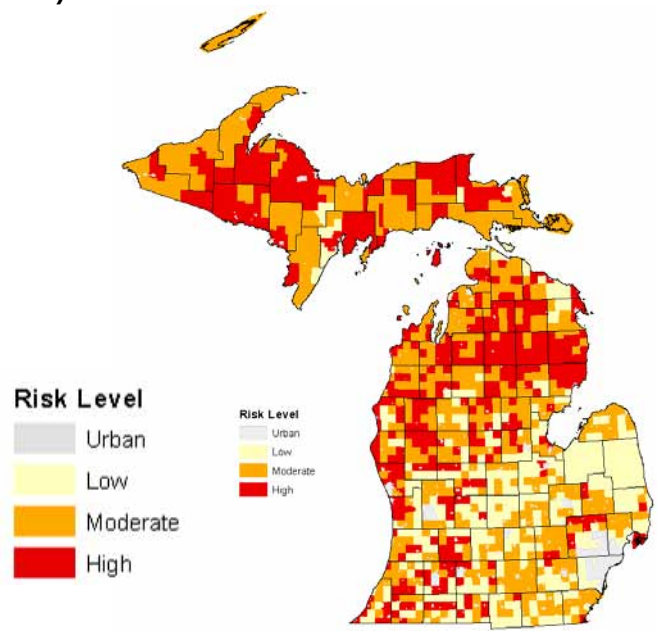
The Ability to Produce Clean Water was generated by the US Forest Service under the Forests, Water, and People assessment. Specific details including data used, processes completed, etc. are available at the following website: http://na.fs.fed.us/watershed/fwp_preview.shtm. The data is a 30 meter resolution raster file.

Commercial Forest Lands



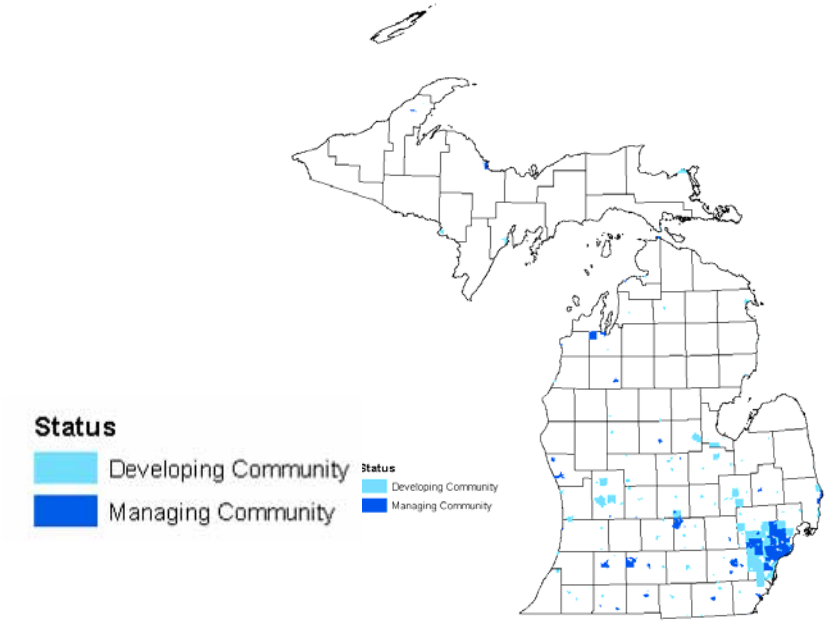
Commercial Forests Lands were digitized via parcel mapping. This is a live dataset edited and managed by the DNRE. The data is a vector polygon file that was extracted in November of 2009. For details about Michigan's Commercial Forest program, go to the following website: http://www.michigan.gov/dnr/0,1607,7-153-30301_30505-34016--,00.html.

Communities at Risk (Fire Risk)



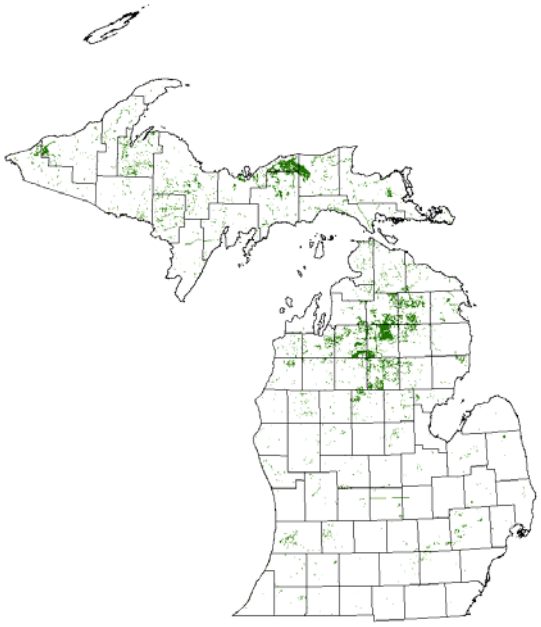
Communities at Risk indicates the level of wildfire risk based on the number of fire response stations and proximity per township (since most fire response agencies are township based). The data is a vector polygon file created by the DNRE in November of 2009.

Community Accomplishment Reporting System (CARS)



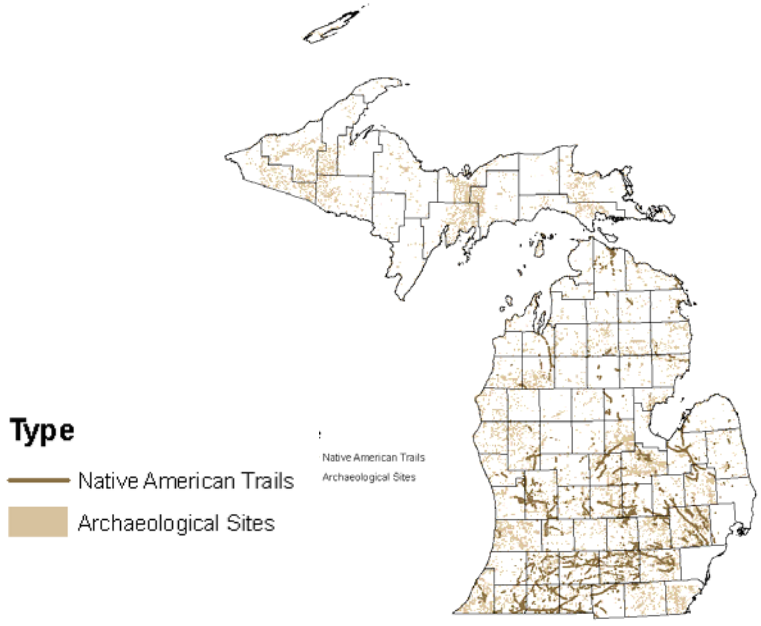
The CARS data is created and managed by the US Forest Service using four criteria (street tree inventory and management plan, professional forestry staff, tree ordinance, and tree advisory group). Communities with all four criteria are considered managing, and communities with at least one are considered developing. The data is a vector polygon file generated from the 2009 CARS database.

Conservation Easements



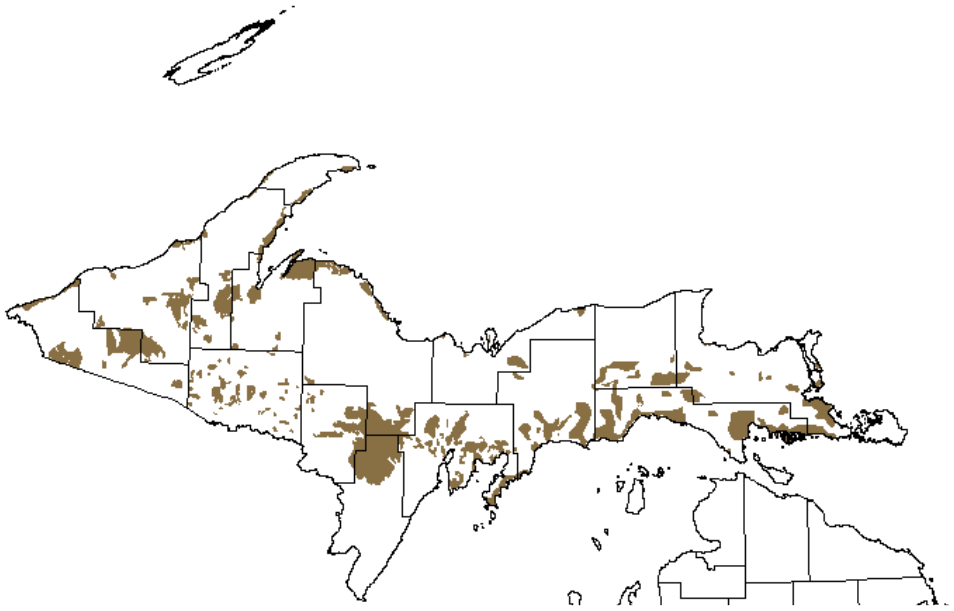
Conservation Easements are a combination of data from the DNRE, TNC, and other easements found in the Ducks Unlimited's Conservation & Recreation Lands (CARL) 2007 dataset. The data is vector polygon files from different years. This dataset was created in November of 2009.

Cultural and Historic Areas



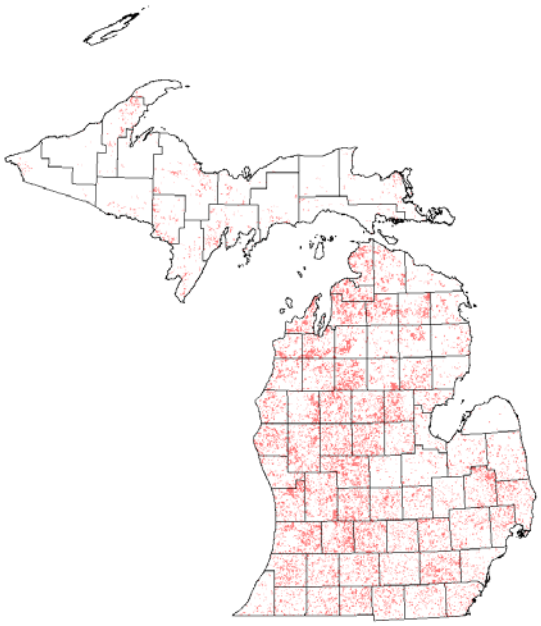
Cultural and Historic Areas include the General Land Office (GLO) Native American Trails and the Archaeological Sites database. The Native American Trails were created from the surveys of Michigan that were completed in the 1800's. The Archaeological Sites database is a live dataset that is updated and edited by the DNRE.

Deer Wintering Areas



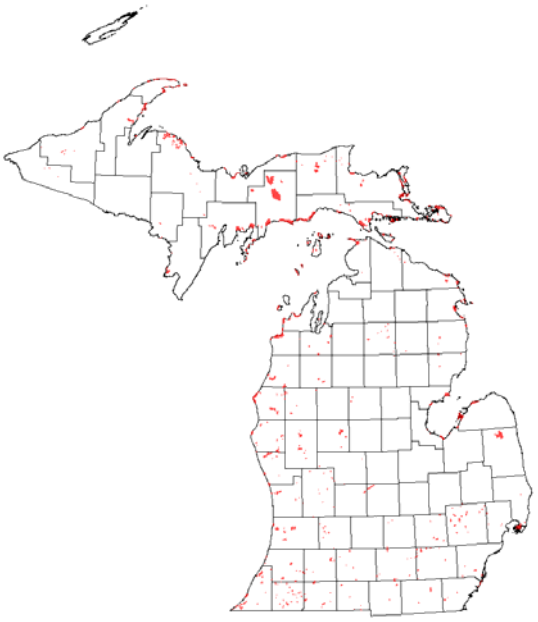
Deer Wintering Areas data is managed by the DNRE. Currently, only the Upper Peninsula has digital data for these areas. The data was created in 2007 as a vector polygon file.

Development Threat 2000-2030



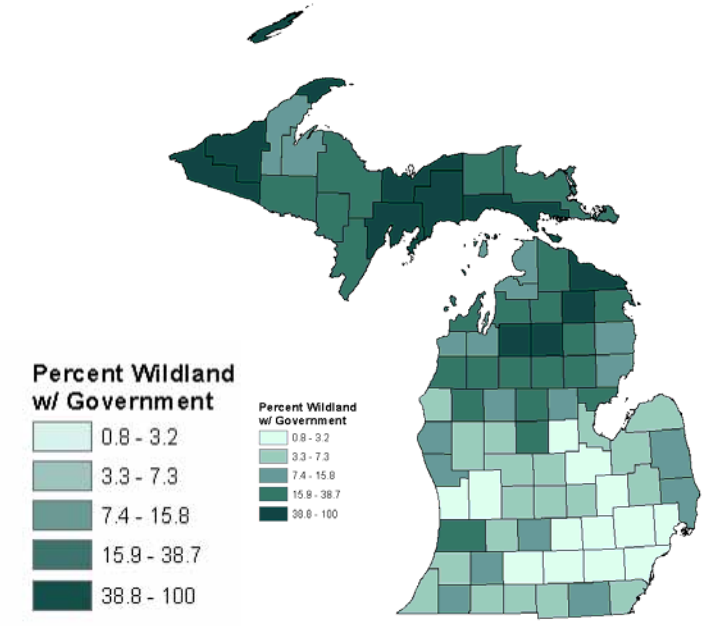
The Development Threat 2000-2030 data was developed by Dr. David Theobald, of Colorado State University, as a national dataset. For specific details on the data used, processes completed, etc. please visit the following website: http://www.ecologyandsociety.org/vol10/iss1/art32. The data was created in 2003 as a 30 meter resolution raster file.

Ecological Reference Areas



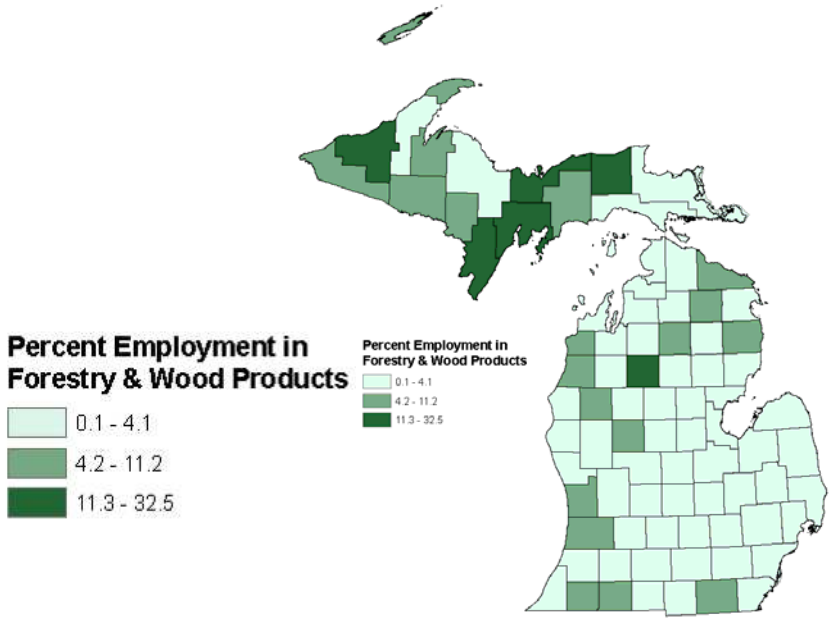
Ecological Reference Areas (ERAs) are a subset of the Michigan Natural Features Inventory's (MNFI) Element Occurrence Dataset. The specific criteria for ERAs are found at the following website: http://www.michigan.gov/documents/dnr/ConservationAreaRecProcess_175755_7.pdf. The ERAs are managed by the DNRE as vector polygon files created in 2005.

Economic Dependence on Forest Resources



Economic Dependence on Forest Resources was created by the US Forest Service using 1990 US Census data. Estimates are for the percent total county earnings derived from four broad industry aggregates; timber, grazing, mining, and recreation and also wildlife. The data includes both direct and indirect (multiplier) earnings estimates. The data is a vector polygon file.

Employment in Forestry and Wood Products (Percent)

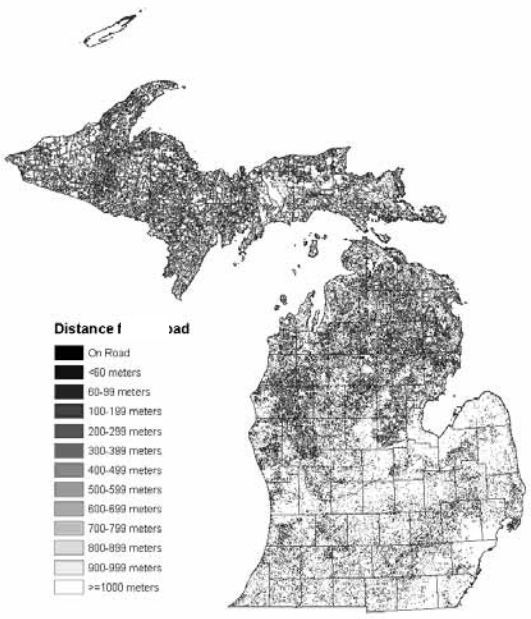


The Employment in Forestry and Wood Products dataset was created from the 2007 County Business Patterns employment data and includes forestry management, wood furniture, and paper manufacturing jobs. The data is a vector polygon file that was created in November of 2009.

Erosion Potential

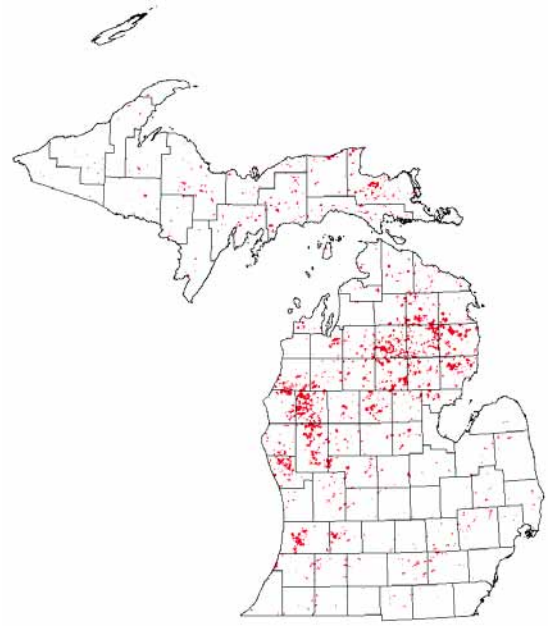
Erosion Potential data was created from the National Resources Conservation Service's (NRSC) Ssurgo Soils dataset. Specific values were extracted from the following attributes; wind erosion (severe designation with a slope >= 12%), k-factor (high designation), and human disturbance (severe designation). The data is a vector polygon file created from the most current versions (as of November 2009) of the Ssurgo soils data.

Forest Distance from Road



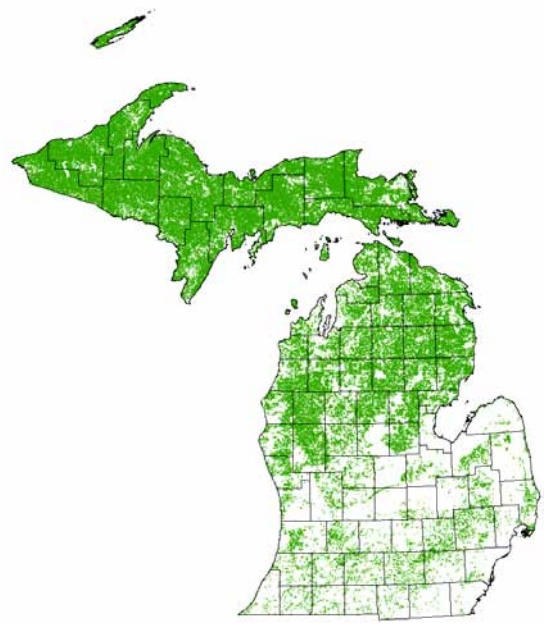
Forest Distance from Road was created by the US Forest Service. Data was grouped into twelve classes measuring the distance of all forested areas from roads. The USGS 2001 NLCD was used for the forested areas and the 2000 TIGER dataset was used for roads. The data is a 30 meter resolution raster file.

Forest Health Risk



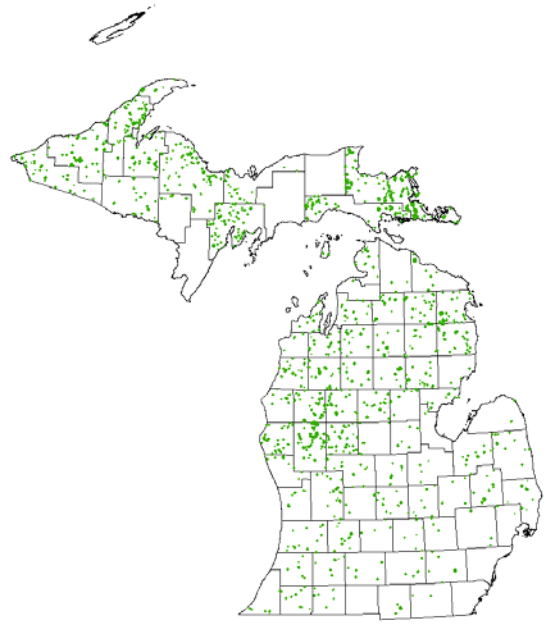
Forest Health Risk data was created by the US Forest Service through the National Insect and Disease Risk Mapping (NIDRM) project. For specific details about the NIDRM project, go to the following website: http://www.fs.fed.us/foresthealth/technology/pdfs/hazard-risk-mapmethods.pdf.
The data is a 30 meter resolution raster file created in 2006.

Forest Patch Size



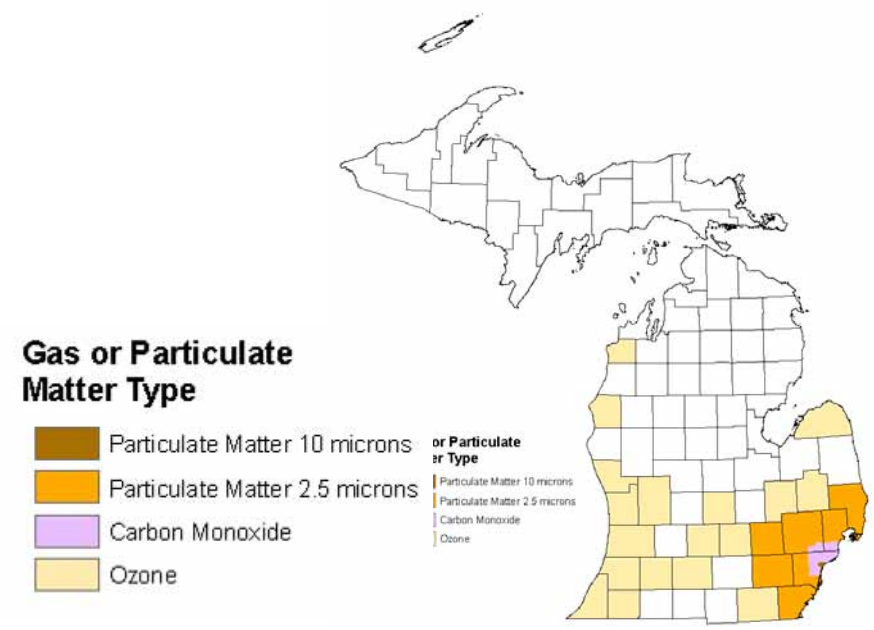
Forest Patch Size was created by the DNRE. The Upper Peninsula (UP) and the Northern Lower Peninsula (NLP) were assigned the same acre values of 500 acres. The Southern Lower Peninsula (SLP) was assigned a smaller value of 250 acres. The regions were separated using the ecoregions developed by David Cleland. The data is a 30 meter resolution raster file created in November of 2009.

Forest Stewardship Plans (Active)



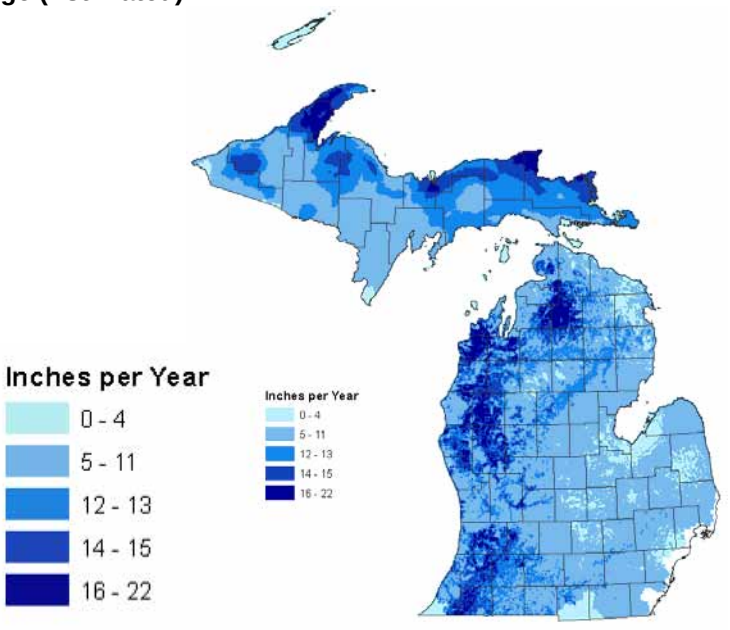
Forest Stewardship Plan areas were digitized by the DNRE using the legal descriptions included in the plan documents. Only active plans (plans developed in the last 10 years) are included. The data is a vector polygon file created in November of 2009. For details about Michigan's Forest Stewardship program, go to the following website: http://www.michigan.gov/dnr/0,1607,7-153-30301_30505-107504--,00.html.

Gases and Particulate Matter



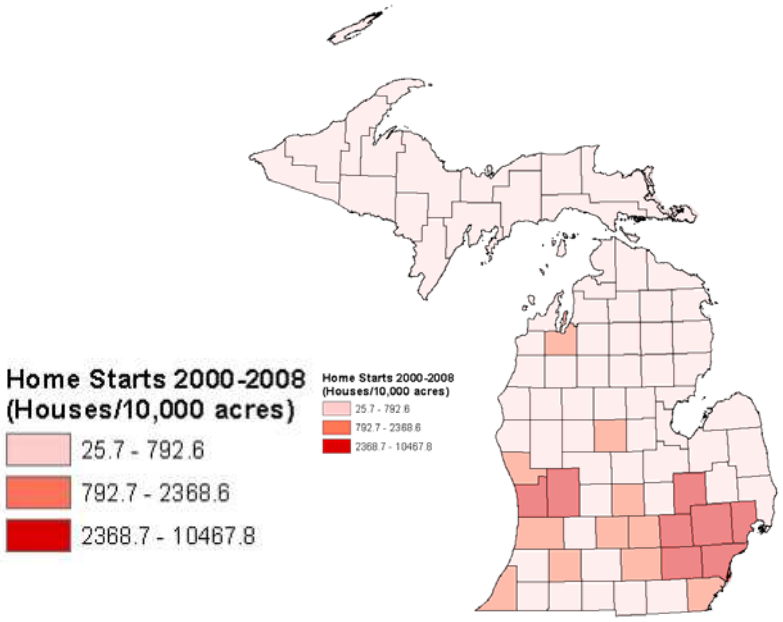
Gases and Particulate Matter files were created by the Environmental Protection Agency (EPA). For more details about the criteria involved, go to the following website: http://www.epa.gov/ttn/naaqs/. The data is a vector polygon file created in November of 2009.

Groundwater Recharge (Estimated)



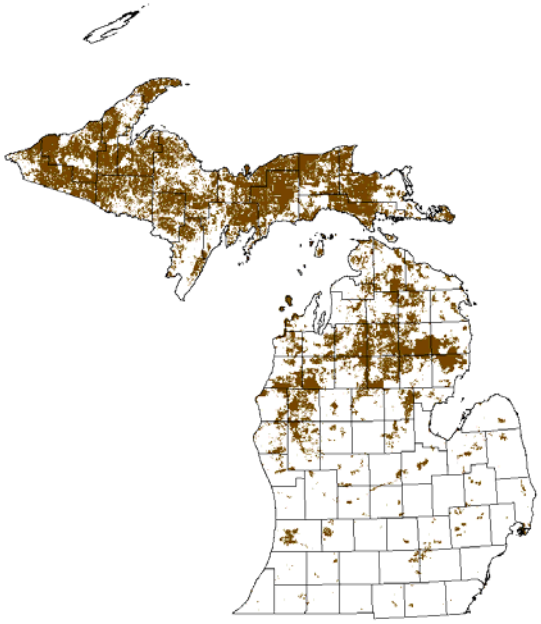
Estimated Groundwater Recharge was created through the Groundwater Inventory and Mapping Project completed by the Michigan Department of Environmental Quality, USGS, and Michigan State University. For specific details about the project, go to the following website: http://gwmap.rsgis.msu.edu/. The data is a vector polygon file created in 2005.

Home Starts (Housing Starts)



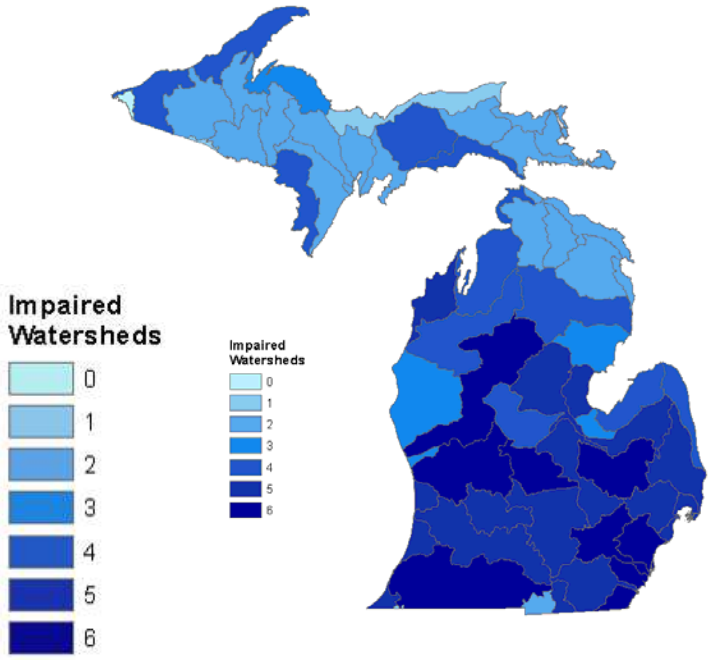
Home Starts was created by the DNRE using 2000 and 2008 US Census data. County data was normalized by acreage values. The data is a vector polygon file created in November of 2009.

Huntable Lands



Huntable Lands were created by the DNRE Mi-HUNT project. For specific details about the Mi_HUNT project, go to the following website: http://www.michigan.gov/dnr/0,1607,7-153-10371_14793_55471---,00.html. The data is a vector polygon file from the most recent data versions.

Impaired Watersheds

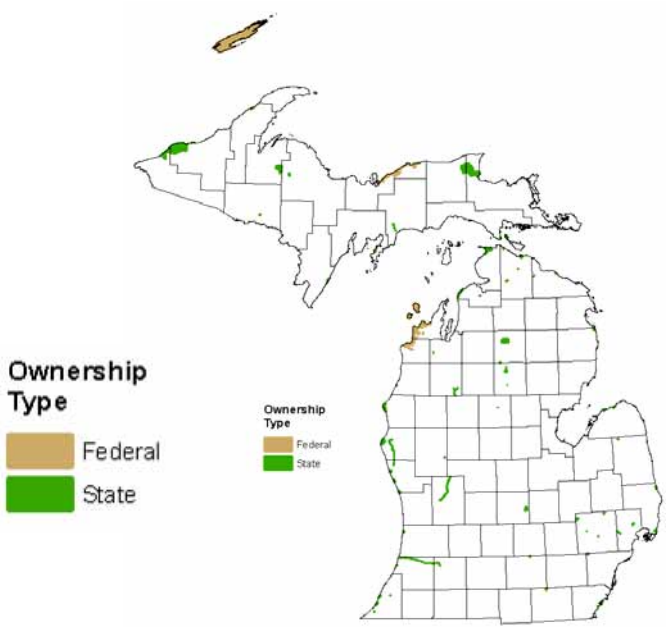


Impaired Watersheds were created by the DNRE, using the EPA criteria for impaired water bodies. The values are derived from the number of types of impaired water bodies was recorded for each watershed. The impaired water bodies are all not supporting types; Coldwater Fishery, Fish Consumption, Other Indigenous Aquatic Life and Wildlife, Partial Body Contact, Public Water Supply, Total Body Contact, and Warm water Fishery.

Impervious Surface

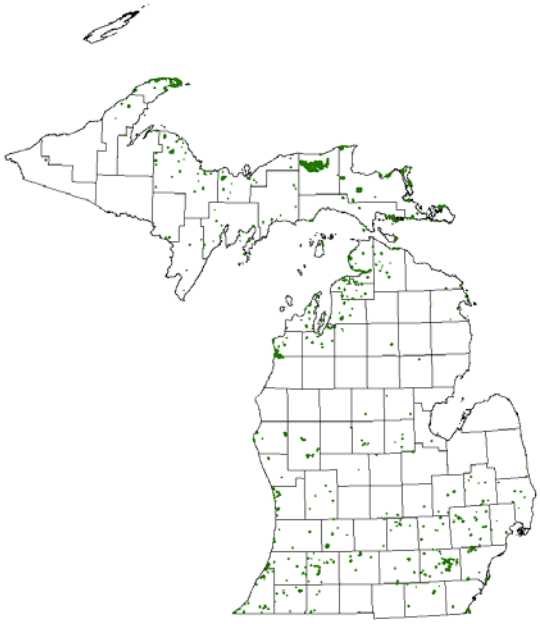
Impervious Surface was created by the US Forest Service using the US Department of Transportation roads data and the USGS 2001 NLCD. Impervious surfaces include roads, parking lots, buildings, etc. The data is a 30 meter resolution raster file.

National and State Parks



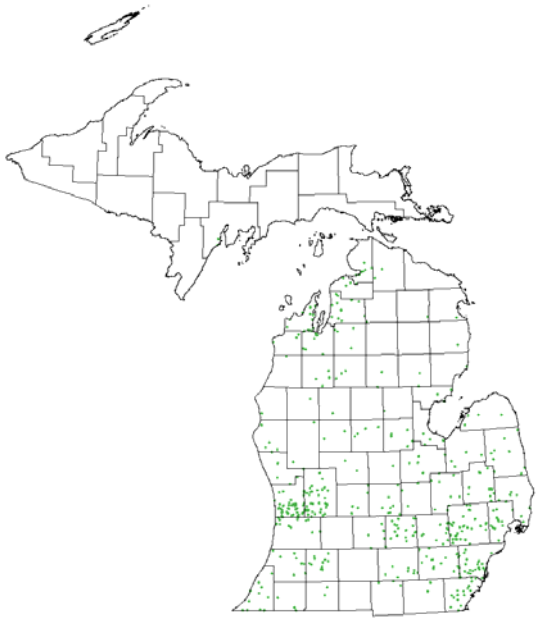
National and State Parks was created by the DNRE by combining the National Park boundaries available on the National Park Service (NPS) website and the State Park boundaries managed by the DNRE. The data is a vector polygon file created in December of 2009.

Nature Reserves



Nature Reserves were compiled from DNRE Natural Areas, TNC Nature Preserves, and other nature reserves designated in the Ducks Unlimited's CARL dataset. The data is a vector polygon file that was created from the most current versions in December of 2009.

Nursery Locations (1 Mile Buffer)

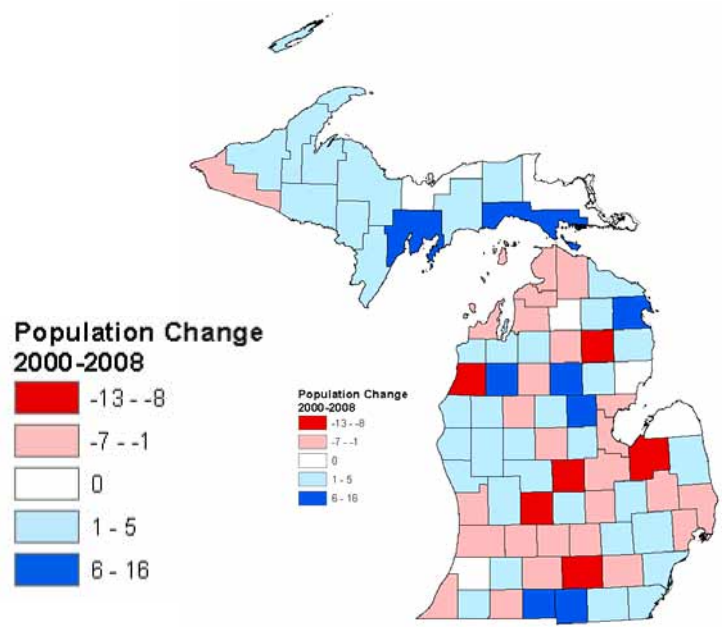


Nursery Locations were generated from the Michigan Department of Agriculture (MDA) database. To account for immediate areas potentially affected by nursery stock, a one mile buffer was applied to the point locations. The data is a vector polygon file created in December of 2009.

Open Space

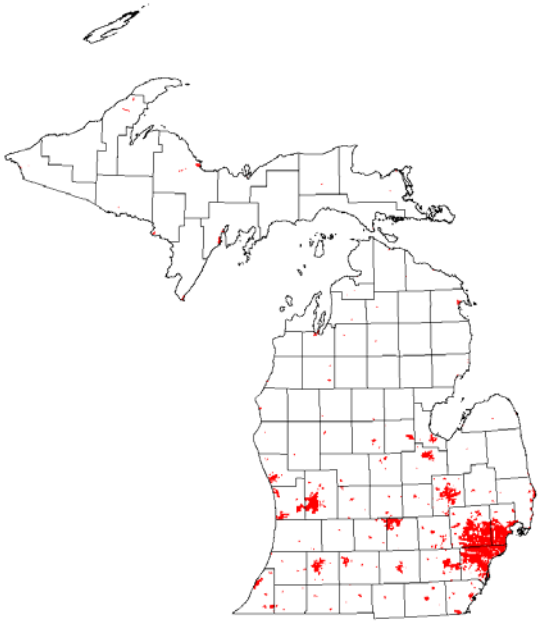
Open Space was generated from the 2001 (Integrated Forest Monitoring Assessment and Prescription) IFMAP Landuse/Land Cover dataset. Landuse types such as forest cover, urban, agriculture, water, etc. were removed. The data is a 30 meter resolution raster file.

Population Change



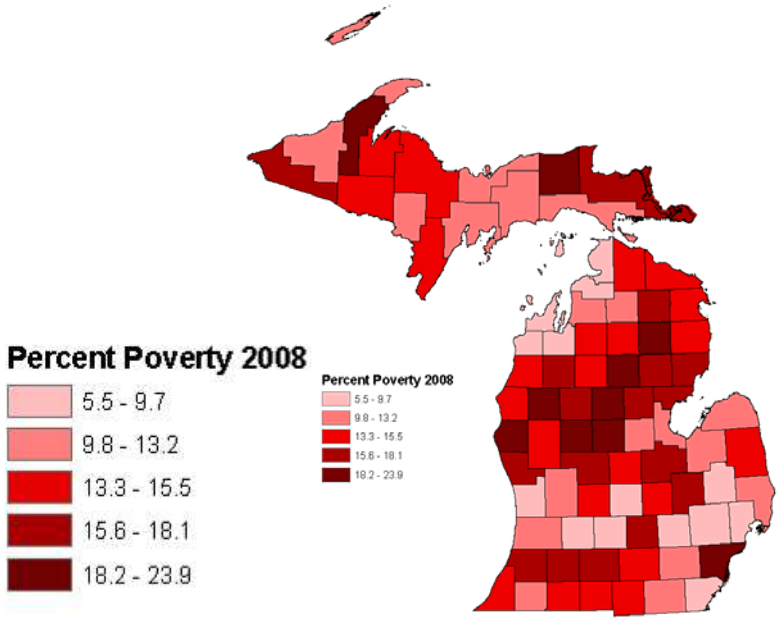
Population Change was created by the DNRE from 2000 and 2008 US Census data. The values represent percent change from 2000 to 2008. The data is a vector polygon file.

Population Density



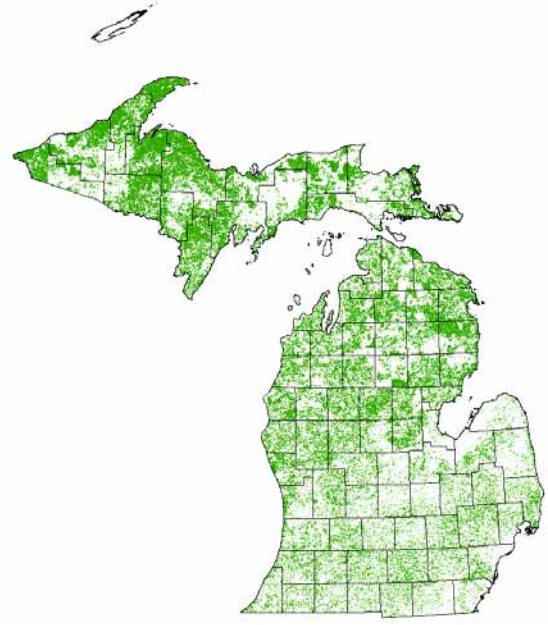
Population Density was created by the DNRE from 2000 US Census data. All communities (cities, villages, Census designated places, etc.) with a population >= 1,000 per square mile were included in this dataset. The data is a vector polygon file created in November of 2009.

Poverty



Poverty values were derived from the 2008 US Census data. The data is a vector polygon file created by the DNRE in November of 2009.

Private Forestlands

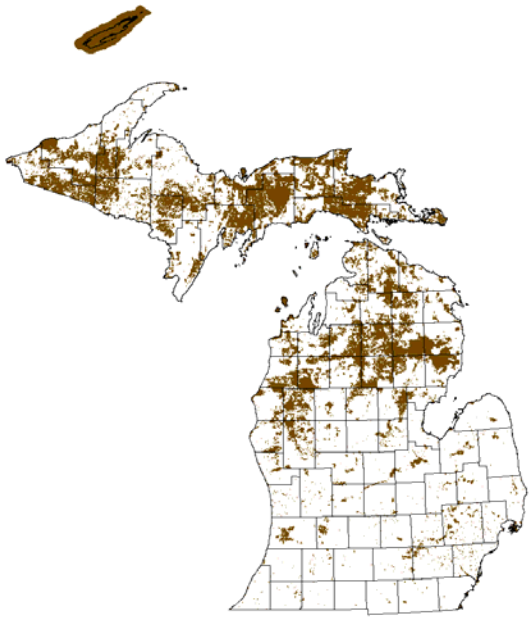


Private Forestlands were created by the DNRE by removing all public lands (federal, state, county, local, etc.) from the forest cover extracted from the 2001 IFMAP Landuse/Landcover dataset. The data is a 30 meter resolution file created in November of 2009.

Proximity to Public Lands

Proximity to Public Lands was created by the DNRE. All lands within ½ mile of public lands (federal, state, county, local, etc.) are included. The data is a vector polygon file created in November of 2009.

Public Lands

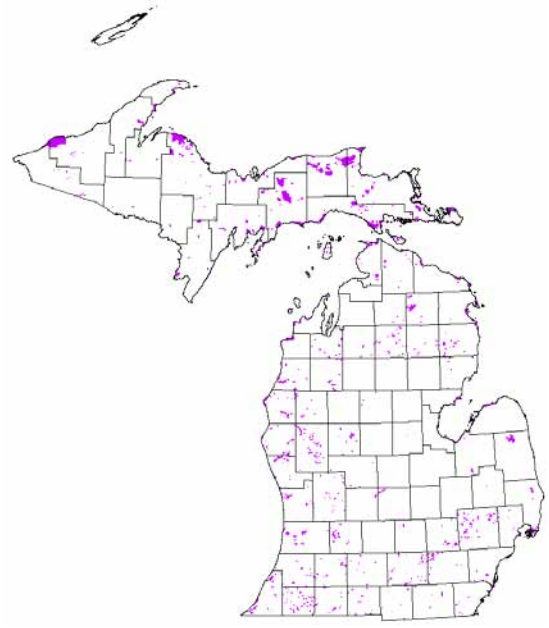


The Public Lands dataset was created by the DNRE. The areas include data from the following sources, NPS, US Forest Service, DNRE, and Ducks Unlimited's CARL dataset. The data is a vector polygon file created in November of 2009.

Qualified Forest Lands

The Qualified Forest Lands were from the Forest Stewardship database managed by the DNRE. For specific details about the Qualified Forest program, visit the following site: http://www.michigantownships.org/downloads/fact_sheet_qfp_kpw_revision_august_2007.pdf. The data is a vector polygon file created in November of 2009.

Rare Communities

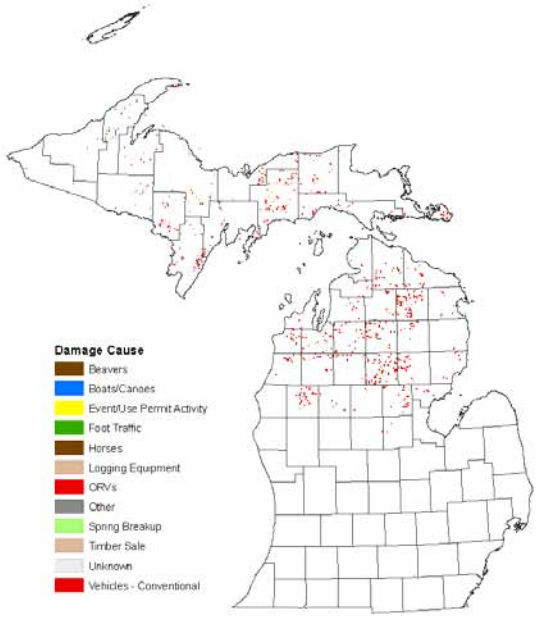


Rare Communities were extracted from MNFI's Element Occurrence database. For specific details about the criteria for Rare Communities, see the following website: http://www.michigan.gov/dnr/0,1607,7-153-10319-56243--,00.html. The data is a vector polygon file created in November of 2009.

Recreational Trails

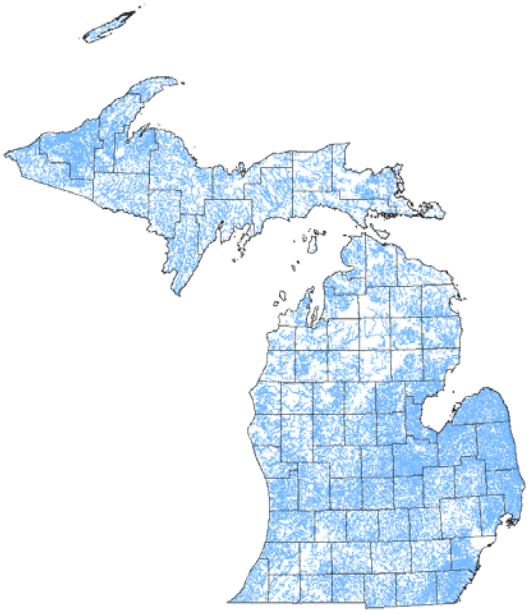
The Recreational Trails data includes designated trails in National Parks, US Forest Service lands, and State of Michigan lands. Other trails will be included as data becomes available. The data is a vector line file created in December of 2009.

Resource Damage Records



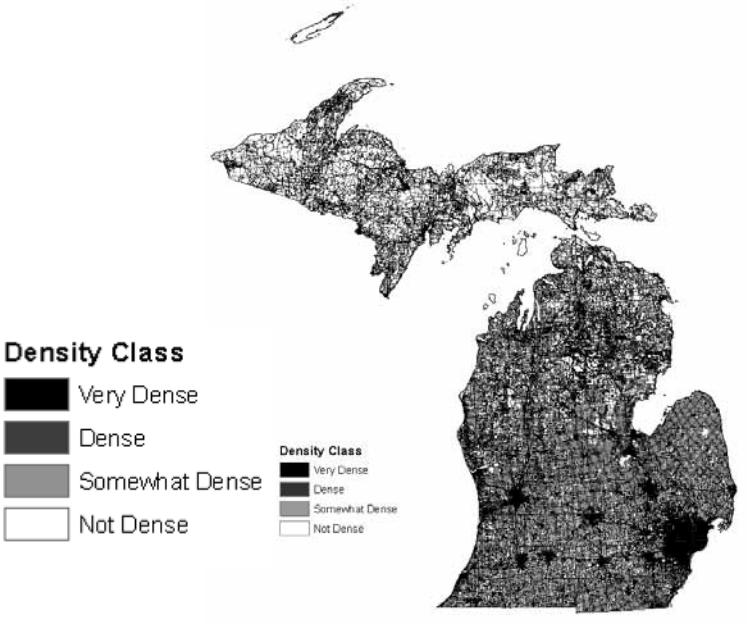
Resource Damage Records are managed by the DNRE to document and track damage to resources (water, soil, forests, etc.). The data is a vector point file created in November of 2009.

River Corridors



River Corridors include a 100 foot buffer around all perennial rivers and streams from the Michigan Center for Shared Solutions' (MCSS) Geographic Framework dataset. The data is a vector line file created in November of 2009.

Road Density

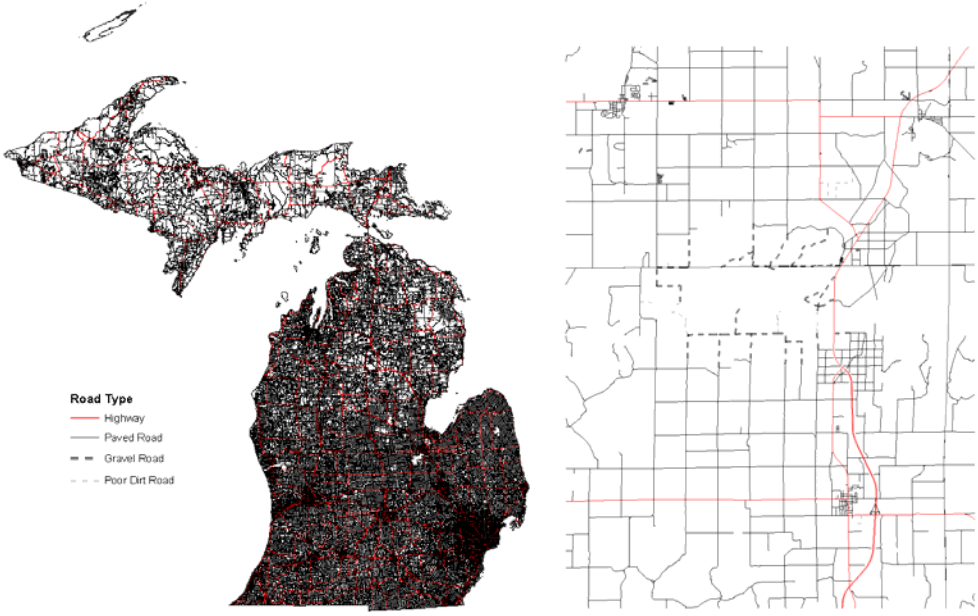


Road Density was created by the US Forest Service using the 2002 US Department of Transportation roads data. Data is a 30 meter resolution raster file.

Road Locations

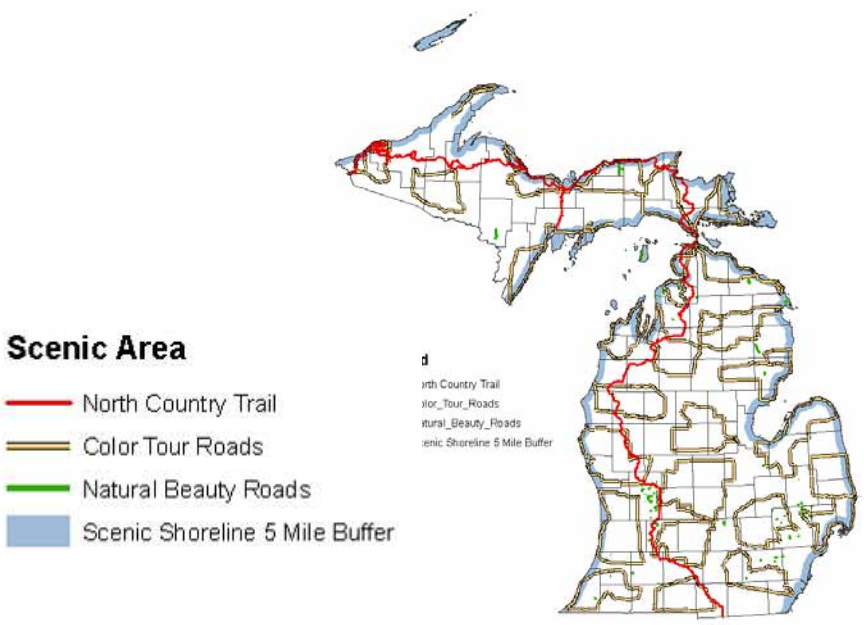
Road Locations are from the MCSS's Geographic Framework dataset. The data is a vector line file created in November of 2009.

Road Type (Surface Type)



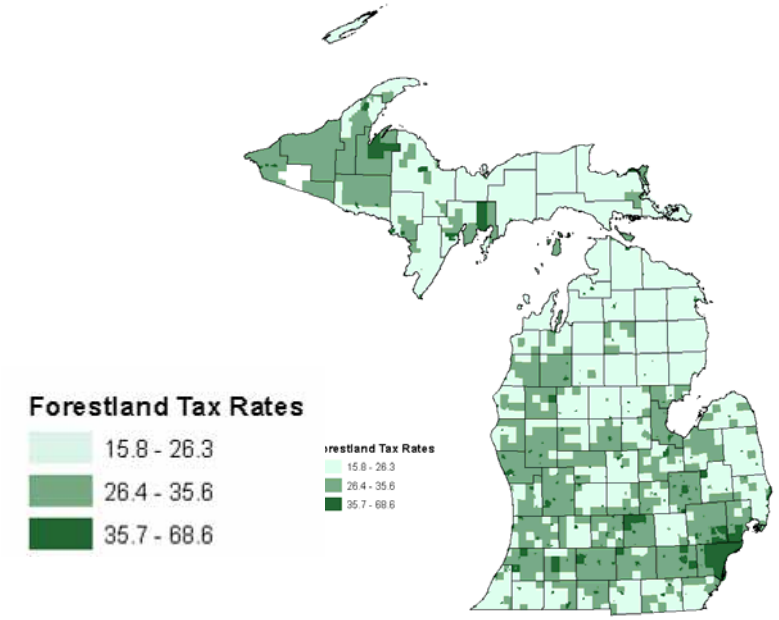
Road Type was generated from the DNRE Forest Compartment Review Process. The roads layer is from the MCSS's Geographic Framework dataset. The data is a vector line file created in November of 2009.

Scenic Areas



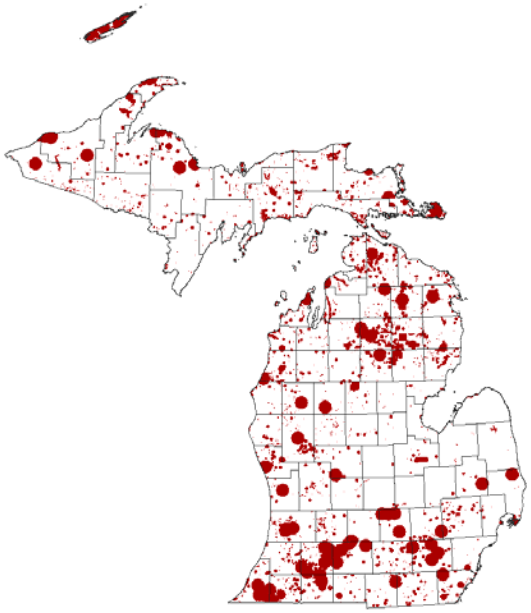
Scenic Areas were generated from the Forest Legacy program. The data is both a vector line file (North Country Trail, Color Tour Roads, and Natural Beauty Roads) and a vector polygon file (Scenic Shoreline 5 Mile Buffer). All data in the map was generated in November of 2009.

Tax Rates on Forestland



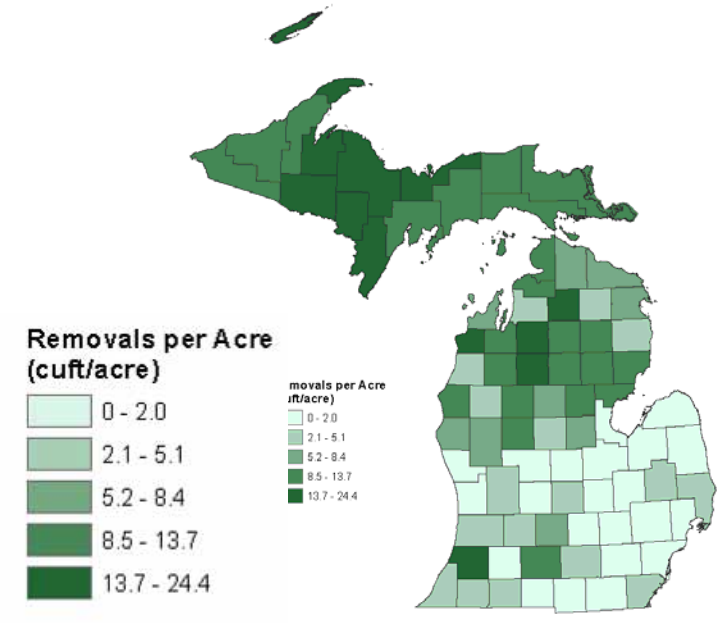
The Rates on Forestland dataset was generated from the 2008 Michigan Treasury database using the Homestead Tax Rates per Township. Values exclude Commercial Forests and Qualified Forest Lands. The data is a vector polygon file created in November of 2009.

Threatened and Endangered Species



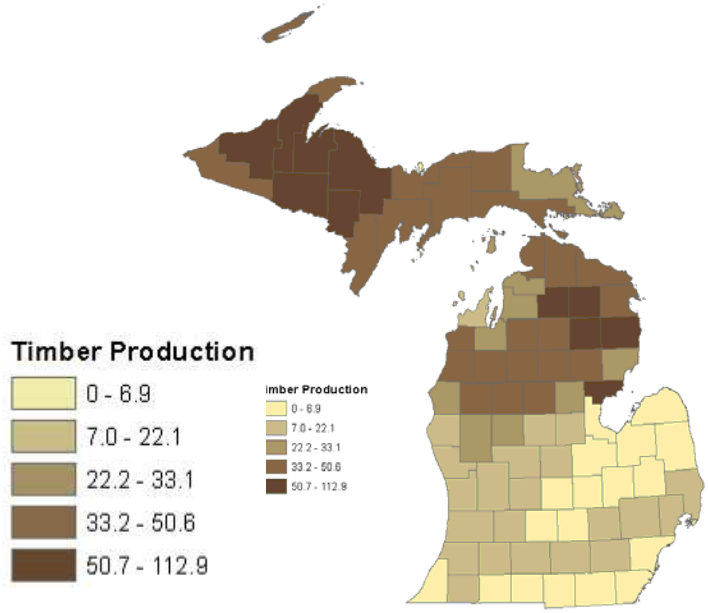
The Threatened and Endangered Species data is managed by MNFI and housed in the Element Occurrence database. This dataset is updated as new species are found. The data is a vector polygon file that was created in November of 2009. For more information about MNFI's data, criteria, etc., go to the following website: http://web4.msue.msu.edu/mnfi/.

Timber Markets



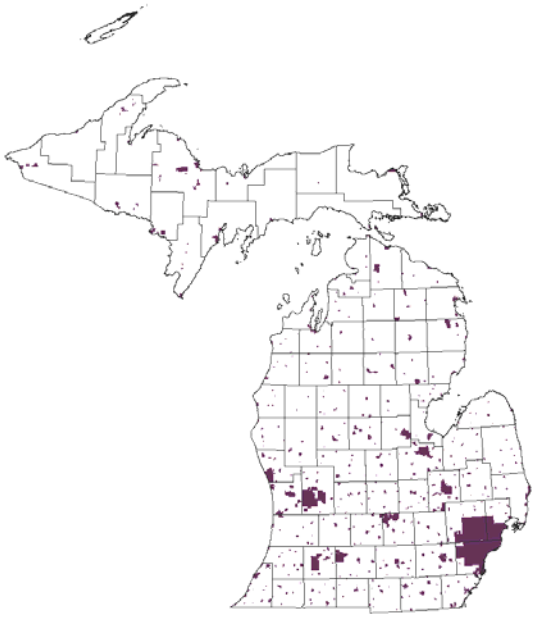
Timber Markets data was created by the DNRE using the 2008 FIA timber data (cuft/year) and was normalized by county acres. The data is a vector polygon file that was created in December of 2009.

Timber Production



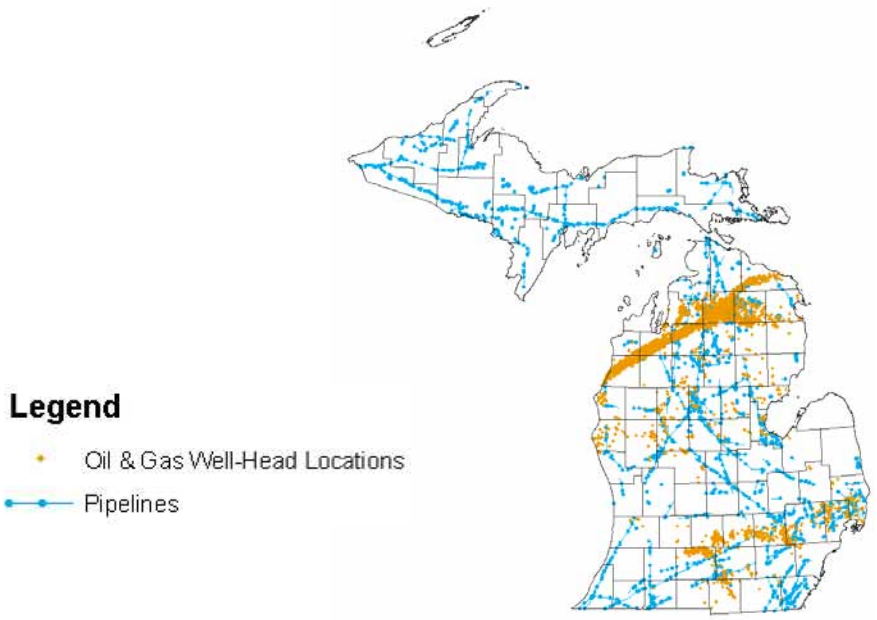
Timber Production was created by the DNRE using the US Forest Service Timber Products Output (RPA) online application. 1997, 2002, and 2007 (only 3 years available digitally) data were combined for county values (cuft/acre). The data is a vector polygon file that was created in November of 2009.

Urban Areas (Maryland Method)



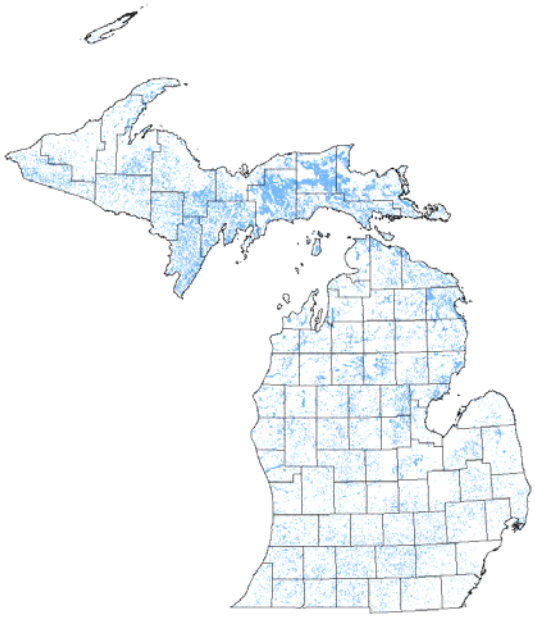
Urban Areas were created and developed by the Maryland Department of Natural Resources. Communities matching a certain criteria are included in this layer. For specific details about the criteria, go to the following website: http://www.northeasternforests.org/FRPC/files/1238445508Geospatial%20Resource%20Guide%20for%20Urban%20Component%20of%20State%20Assessments.pdf. The data is a vector polygon file that was created in 2008.

Wellheads and Pipelines



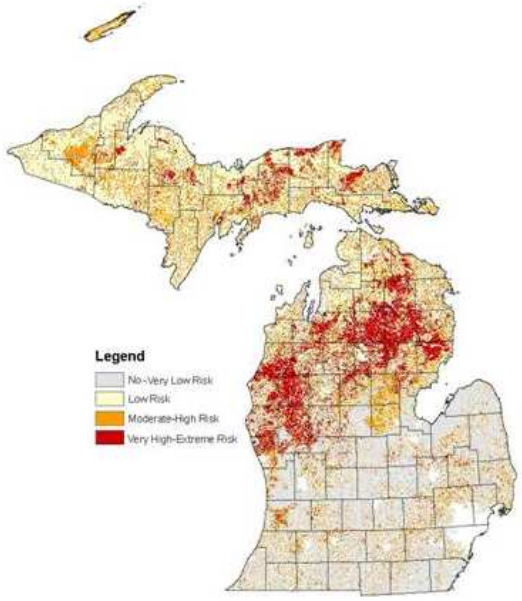
Wellhead and Pipeline data are managed by the DNRE. Both datasets are updated regularly. The wellhead data is a vector point file, and the pipeline data is a vector line file. Both were created in November of 2009.

Wetlands



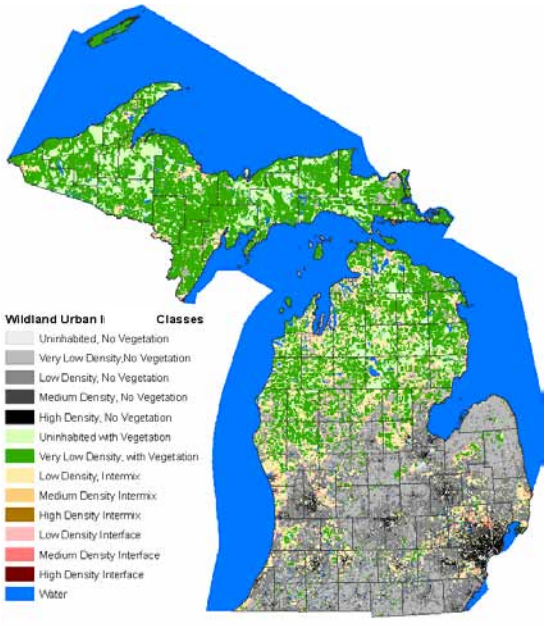
Wetlands were generated from three sources (1978 USGS Topographic Quadrangle Maps, National Wetlands Inventory (NWI), and NRSC Ssurgo Hydric Soils). Due to potential accuracy, standards issues, etc., the wetlands used for this analysis were areas designated by at least two of the three sources listed. The data is a vector polygon file that was created in November of 2009.

Wildfire Risk



Wildfire Risk was created by the US Forest Service by combining vegetation type with fuel models. The data is a 30 meter resolution raster file that was created in 2009.

Wildland Urban Interface



Wildland Urban Interface was created by the University of Wisconsin. For specific details about the data, classes, etc., go to the following website: http://silvis.forest.wisc.edu/projects/WUI_Main.asp. The data is a 30 meter resolution raster file that was created in 2007.

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